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EDITORIAL ANNOUNCEMENTS.

THE BRITISH AND EASTERN CONTINENTS edition of the Railroad Gazette is published each Friday at Queen Anne's Chambers, Westminster, London. It consists of most of the reading pages of the Railroad Gazette, together with additional British and foreign matter, and is issued under the name Railway Gazette.

CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. We give in our editorial columns OUR OWN opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.

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VOL. XXXIX, No. 5. FRIDAY, AUGUST 4, 1905.

The Government's last quarterly accident bulletin, reprinted on another page of this paper, contains a new feature—a statement of the losses for six months by derailments at derailing switches. They amounted to $48,387, not counting damage to freight or sums paid for personal injuries, which very likely swell the loss by many thousands. Whether or not collisions would have occurred in these cases if the derails had not been there is a conundrum for the curious on which the Government record sheds no light. It is plain, however, that if the derailer is to be employed as a "moral safeguard"—a warning to enginemen that if they disregard stop signals they will be found out and penalized, there is room for improving it; for two of the derailments are charged to the misconduct of the signalmen, one to a defect in the derailer itself, and one to freezing of a signal. This bulletin contains the report of the rear collision at Clifton, Pa., March 3, when seven passengers were killed. The details given tend to confirm the evidence that the engineman, though possessed of years of experience and a good reputation, took chances; that, having found signals clear for 12 miles he concluded to run the risk of finding them so in the 13th mile. This bulletin contains the first reference, in the four years since the records were begun, to a collision caused by an intoxicated engineman. The causes of coupling accidents are in this bulletin classified more in detail than heretofore, and we copy the detail table. This analysis serves to put on record an exhibit of what a great variety of mishaps a brakeman is liable to, but otherwise is of very moderate value. As is pointed out in the bulletin, many of the accidents are of kinds not peculiar to coupling and will continue to occur even if every coupler be ideally automatic and ideally perfect. Many accidents are due to deliberate risks taken by the men who suffer them, as when one jumps on the front of a moving engine to open a knuckle. Again, it appears that cars not equipped with automatic couplers are still in service here and there. No less than 16 fatal injuries, out of 62, occurred when the victim was by himself, so that no witness was left to give information about the cause. In Table 3A, classifying the injuries, 281 cases out of 790 were contusions or lacerations of fingers. Seven of the 18 passengers killed in collisions were riding in cabooses on freight trains.

The Royal Commission appointed in 1903 by King Edward to inquire into the means of locomotion and transport in London, and to suggest improvements in the same, has made its report, which is a bulky affair, filling eight volumes. The report proper, however, is contained in the first volume; the others dealing with minutes of evidence and other supplementary matter. The situation at the present time, summed up briefly, seems to be that London is a great, ill-arranged city, composed really of a collection of communities which are not ready to merge their private rights of control, especially that of the veto power, into any central body that can provide a harmonized scheme. The heart of London lies in an oval, some four miles long and two miles wide, with railroad stations at different points on its boundary, but no efficient scheme of rapid transit within. The streets are very narrow and crooked, and most of the local governing bodies—which have the power of veto—are unalterably opposed to tramway lines in these streets. The result is that except for a limited amount of east and west traffic on the borders of the oval, served by the Metropolitan District, and for a smaller amount going out towards Shepherd's Bush from the Bank on the Central London, cabs constitute the best means of rapid transit, with the lumbering omnibuses a close second. The commission in the first part of its report is bold, and advocates as a fundamental basis of relief the construction of two great boulevards—one east and west and one north and south—each somewhat over four miles long, to run through the heart of the congested part of London. It would put four-track subways beneath these boulevards, and four-track tram lines on the surface, with abundant room for vehicle traffic on either side of the rails. Unfortunately, the cost of any such enterprise seems hopeless; although the commission suggests an ingenious way by which the municipality could be in part recouped, through right to purchase abutting property at existing prices and hold this property for the great increase which might logically be expected to follow the improvements. But the commission itself does not take this great thoroughfare plan too seriously, and says that the other improvements suggested must not wait for it. The other improvements consist primarily in a scheme of tramways to connect up the stub-ended system of the present day and really accomplish something. Before this can be done, the individual veto powers previously referred to must be done away with. It is proposed to supplement these tramways with additional subway routes, and this part of the plan is important, for, at the prevailing British tramway speed, the relief which they could afford would necessarily be limited. London has a tough problem before it. Real relief seems impossible without the existence of broad thoroughfares in place of the tangle of narrow and crooked streets, but we fear it will be a long time before such thoroughfares will exist.

THE WACHUSETT DAM.

Of the great masonry dams which have been built for the storage of water, the principal ones in this country are the one at San Mateo, California, which has a height of 170 ft. above the ground, and a storage reservoir with a capacity of 32,000,000,000 gallons; the

new Croton Dam, which is founded on the rock and is 290 ft. high, and the new Wachusett dam at Clinton, Mass., 228 ft. high and 1,250 ft. long (20 ft. shorter than the Croton dam), but which has an average depth of water of 46 ft. behind it, and a capacity in the reservoir of 63,068,000,000 gallons, or about double the Croton reservoir, which holds 32,000,000,000 gallons. The completion of this important work, in its essentials, has just been announced, and a description of some of the principal features in the design and construction, together with plans and photographs, appears elsewhere in this issue. It has been about nine years in building, and it will probably take the balance of the present season to entirely finish it. The city of Boston and the adjacent cities and towns will then have an abundant supply of pure water for many years to come. The amount of water used per capita has enormously increased during the last twenty-five years, so that the works built in 1873-1877 on the Sudbury river and its tributaries, which it was expected would be amply sufficient for the needs of the city of Boston for many years, have been long outgrown. When these were planned the amount necessary to be provided was based upon an estimated consumption of water which was considered liberal, viz., 60 gallons per day for each individual. The Water Board, in a special report for the year 1874, says that "as there will probably be means devised at no distant day to check the great waste that has heretofore taken place, an allowance of 60 gallons per day for each person should and, without much doubt, will be ample." The waste or extravagant use of water was, however, not then a new thing. When the original supply was drawn from Lake Cochituate, the capacity of the works was planned with the assumption that 28½ gallons per day for each person would be sufficient, as the Water Board reported in 1838 "that this appears to be the largest quantity furnished to any city which is subject for any portion of the year to the influence of a cold climate, or where the habits of life are of British origin."

This estimate was, however, quickly found erroneous, and in 1849 the consumption of water reached 61 gallons per individual, and in 1851 had risen to 66½ gallons, and in 1856 it was 72 gallons, and the Water Board sounded a note of alarm at the great and needless waste, and complained that "the present supply will soon be exhausted at the present rate," and that it "would be impossible to keep the water in the reservoirs at a suitable height in case of fire." In 1893 the amount supplied had increased to 107 gallons per head, and during 1904 it was 123 gallons, having advanced four gallons per head during the preceding year. (This applies, however, only to the city of Boston, as the average of consumption in the whole Metropolitan District was only 83 gallons per head, which rate is, however, greatly in excess of what was formerly used.) It does not seem possible that the rapid increase in the amount which has been noted will continue, as it is certain that much is absolutely wasted, while the use everywhere is very extravagant. By proper regulation and supervision much of this waste could be stopped, and the existing works be made ample for many years longer than if the present apparent consumption is continued. But should an additional supply become necessary there are other sources which exist in that part of the state lying north and west of the Wachusett reservoir which can be connected to it and made available at a small additional expense, and without constructing any more large works, as the present total consumption of water in the district is but 173,000,000 gallons per day, while the capacity of the aqueduct is 300,000,000. Of the amount used the Wachusett reservoir supplies about 105,000,000, and the balance of the works, 68,000,000.

The preliminary studies and investigations which led to the adoption of the plan of which the building of the Wachusett dam is one prominent feature, were carried on by the Massachusetts State Board of Health during the years 1890 to 1895. They were aided by Frederic P. Stearns, Chief Engineer, who was responsible for the engineering work and estimates which were necessary, and by numerous assistants. Mr. Stearns was selected by the Metropolitan Water Board to have entire charge of the planning and construction of the works necessary for providing, storing, conveying and distributing an adequate supply of water in the Metropolitan District, so that the design and execution of this great project have been from the beginning under his charge. How wisely and with what extensive foresight for the future needs of the metropolis of New England and its suburbs these works have been accomplished, would be perfectly apparent only upon an exhaustive study of the whole of the problems involved, and a complete record of the work that has been done; but the brief and condensed description of this most important part of the scheme will show how faithfully and successfully it has been carried on.

AN ERA OF RAILROAD HEALTH.

The completed record of railroad foreclosures in the year 1904 shows that they covered only 13 roads, with a mileage of 524, and total stock and funded debt of $28,266,000. With the single exception of the year before (1903) this is the lowest annual foreclosure return for the 29 years during which the figures are available. The record of railroad receiverships takes up much the same tale. The number of roads (8) is fourth from the bottom during the twenty-nine years; the mileage (744) is fifth; the amount of stock and bonds affected ($36,069,000) also fifth. But in the receivership list the Detroit Southern, a railroad without head or tail, and a legatee of very weak constituent properties, returns $25,160,000 of the stocks and bonds. If we withdraw that exceptional case we have, as the record for last year, 7 roads with a mileage of 355, and stock and funded debt of $10,909,000. It is probably a fair statement, therefore, that railroad foreclosures and receiverships together for 1904 make the most cheerful showing for any year but one for a period of more than a quarter of a century.

But let us push the statistical evidence still further as a basis for later deduction. Taking railroad foreclosure sales for the last four years they give the annexed figures:

	No. of roads.	Mileage.	Stock and bonded debt.
1901	17	1,139	$85,808,000
1902	20	693	39,788,000
1903	13	555	15,885,000
1904	13	524	28,266,000
Total	63	2,911	$169,747,000

And for the same four years the receiverships supply the annexed returns:

	No. of roads.	Mileage.	Stock and bonded debt.
1901	4	73	$1,627,000
1902	5	278	5,835,000
1903	9	229	18,823,000
1904	8	744	36,069,000
Total	26	1,324	$62,354,000

The receiverships in the last table include the Detroit Southern road.

Comparisons and contrasts with earlier railroad periods can be multiplied to make graphic the showing by the two brief tables of the low ebb to which foreclosures and receiverships—the most searching tests of railroad infirmity—have run. For example, in one year (1896) foreclosures rose to $1,150,377,000, or almost seven times the amount of railroad values involved during the past four years. In 1895 they were $761,791,000, or about four and a half times. One seeks in vain for the record through any period of four years since 1875, during which foreclosures were not vastly in excess of the last four, notwithstanding the great extension of railroads. If we take the receivership returns it will be found that in each of 21 years out of the last 29 years the receiverships involved greater liabilities than during the last four collectively; and, again, one finds no continuous four-year period during which the excess of receivership values is not enormous, while a single year (1893) returns $1,781,046,000, or about 29 times the receiverships of the last four. In round numbers the average foreclosures per year during the 29 years has been $236,000,000, the average for the last four years only $42,436,750, corresponding figures for receiverships being $223,000,000 and $15,588,500, the latter sum including, as stated, the Detroit Southern receivership. But the contrasts need not be amplified further to exhibit the low drop in the railroad bankruptcy curve.

Pointing in the same quarter toward sanity in railroad methods and progress are the returns for railroad construction. They appear for the last six years in the table subjoined:

	Miles.		Miles.
1899	4,588	1902	5,684
1900	4,437	1903	5,786
1901	5,322	1904	4,168

It will be noticed how what we may call the curve of construction is reduced for the last six years almost to a straight line, and that, too, during a period of high speculation and national prosperity, when, if the curve had run upward sharply, it would not have been a surprise. There is no abrupt fall, as in 1883, when new mileage sank from 11,568 to 6,741, nor such a leap as in 1886, when it rose to 9,000, and again to the record high mark of 12,983 in the year following, nor such a low record as followed the year 1893, when new mileage fell below 2,000 for each of four successive years. Other things being equal, the even rise of construction during the last four years suggests a growth sober, methodical and sane, with no hint in it of the chills and fever of Wall Street, and confirming the adjective "sound" so commonly applied in these days to our

railroads as a whole. The foreclosure test, the receivership test and the construction test all center on the same conclusion, saying nothing of the more variable and doubtful test of gross and net earnings, important for immediate purposes as the latter may be.

The causes of the railroad stability indexed by the returns cited do not have to be sought far afield. The prime force is, undoubtedly, that better organization of capital at the great money center which has averted panic and crisis and money stress—sure, in some degree, to involve the railroads—which a good many fiscal prophets predicted, but which have not come. But there are secondary causes as well. Most potential of them has been the swift consolidation of railroads, which has thrown a kind of protective shield over the weaker lines absorbed. As in the familiar fable, where the single stick might have broken, the faggot has been strong. The branch road, which, as an independent line, might have gone to the wall, has found shelter behind the guarantee of the bigger corporation, itself often content to gain from transferred traffic what it loses by operation of the subsidiary road—particularly if the latter is sought by a rival. Exhaustion of territory directly profitable and resulting discouragement of speculative railroad building is another factor. Reduced interest charges in taking care of railroad properties is yet another, and the diversion of capital from the steam to the electric railway enterprises must be reckoned in also as a large component. But above and beyond all these, underlying the present epoch of fiscal and physical sanity of the American railroad, is the long and often bitter lesson which past experience has taught projector, investor and operator alike during the mutations of our great railroad system.

It would be well if we could take one step farther and add that the sanity reflected from minimized foreclosures and receiverships during the last few years had also reached Wall Street; but it is a statement which "high finance" and "holding" companies and the facts of speculation, at once vast in size and novel in shape, forbid. For all these, doubtless, some form of retribution waits, and for others it has already arrived. But the comforting fact remains, writ large, that in spite of those adverse influences, our railroads, as *properties*, have entered a period of sane conservatism. How far that conservatism will resist the next industrial and fiscal crisis when it comes, will be one of the most interesting chapters in our railroad history.

The Use of the Catalogue.

It goes without saying that reference to manufacturers' catalogues is constantly necessary in the conduct of many kinds of business, but it is unfortunately true that catalogues are not always made as valuable either to the user or the maker as they might be, were both sides to take advantage of all the possibilities that exist. A number of years ago it was recognized by the mechanical officers of the railroads that catalogues would be of value if they were properly indexed and arranged, and so the standard sizes came into being. For a time there was some stir in the matter and catalogues assumed a semblance of uniformity, and even that conservative organization that will adopt no standards or assume the responsibility of endorsing or condemning, the American Society of Mechanical Engineers, did accept the report of a committee on the subject of catalogue sizes. But the matter has not been pressed, and the younger men in the business are woefully ignorant of what has been done and how much it is to their interest to follow the prescribed sizes in their catalogue making. At a meeting of the society about two years ago, much disgust was expressed at the summary method of one member who incontinently consigned every catalogue to the waste basket that was not of a standard size and therefore convenient to file. Those who spoke against such wantonness failed to recognize the value to this man of those catalogues that he did save.

The standardizing of catalogues, valuable and indispensable as it may be for convenience of filing and handling, is but half the battle unless the receiver is willing to take some pains to so index what does come in that the contents will be readily and quickly available for instant reference. For this a little, a very little, care is needed. In one case in mind, every catalogue coming into the office of a certain engineer passes through his hands and every item listed therein is underscored. This work does not require an average of two minutes a day. An assistant then takes the catalogue and gives it a number, records the issuer's name in an indexed book and then enters every underscored item on a card index. The total time required is not felt, and the catalogue file is ready at all times for immediate service.

It is impossible to carry in mind the names of all of the makers of any one line of goods, so that an index of this kind is indispensable to any who are obliged to use them. With the system outlined above in force it becomes possible to refer, at a moment's notice, to every catalogue in the office bearing upon any subject, whether it be the minor one of taps and mandrels or the one of greater value which deals with locomotives, or with traveling cranes; and when the indexed catalogues have been produced the owner knows that it is useless to search elsewhere on the premises for further information. Those who merely list the names of the firms issuing the catalogues are handicapped at the start, and the value of the publication depends solely upon the memory of the user. The result, too, is that many catalogues issued by small firms, who do not happen to be known to the head of the department, are lost to sight and buried beneath later accumulations, and straightway become absolutely useless to all concerned, so that they might as well have been consigned to the scrap basket on arrival, for all the good they have ever done or will do.

It is a pity, too, that so many valuable tables and so much engineering data that is published in catalogues should be forever buried, except for an occasional accidental use that comes only when the catalogue happens to be opened at an opportune moment. Much of this data has been compiled at great expense, and it frequently represents a great deal of original and costly investigation. Here again, the memory of the man is a frail reed to lean upon, and the card index should be the sole resort. For data of this kind, as well as for other matters of occasional reference it is advisable to carry a special index. Tables, capacities, and matters of moment can be so listed that they are immediately available, and if not found in the index it will be known at once that they are not in the office.

All this may seem commonplace, and is, but when the condition of the catalogues in the larger portion of the railroad offices is considered, and this is coupled with the disregard of most manufacturers for the convenience of the user, it is quite in order to jog the minds of both parties as to the value of the commonplace. In the great majority of offices there is a mass of valuable information thrown aside on dusty shelves, or packed away in improperly indexed packages, that would immediately become available and extensively used if only the head of the department or some one of his principal assistants had a proper appreciation of the full value and the use that can be made of the catalogue, when all of its resources are listed in such a manner that they may be used without resorting to the nervous and exhausting process of a long search.

NEW PUBLICATIONS.

Civil Engineering. By Lieut.-Col. G. J. Fiebeger, U. S. A., Professor of Engineering, U. S. Military Academy. New York, 1905: John Wiley & Sons. Cloth, 573 pages. Price, $5.

Civil engineering in all its branches is a big and broad subject to crowd into a book of 573 pages and if the author's purpose of preparing a text-book for a short course in civil engineering for students at the Military Academy was not frankly stated in the preface we should be inclined to wonder how any one could get up the courage to tackle such a comprehensive theme. The course of study at West Point is peculiar in its wide latitude, including as it does an excellent foundation in many subjects and a mere smattering of others, and this text-book is likewise peculiar in its mixture of elementary principles and extended higher mathematical discussions. But the aim of the author is apparent throughout. He has tried to lay the groundwork for a knowledge of the more important principles and facts needed by an army officer who may be called upon to work out problems in civil engineering both in times of peace and in times of war. In dealing with applied mechanics and the theory of strength and elasticity, less theory and more practical information might perhaps have been included, for while the theoretical considerations are of course highly important, the man who is building a temporary bridge to pass a waiting army wants to know primarily how much a beam will stand and not why it will stand that much.

The wide range of subjects treated—each of them worth a whole volume or volumes—includes elementary stresses, strength and elasticity of beams, effects of moving loads on beams, column formulæ, design of riveted and pin connections, analysis of stresses in framed structures, masonry dams and retaining walls, masonry arches, hydraulics, timber, properties of metals, properties of stone and cement, masonry, foundations, bridge design, roofs, highways, water supply and sewerage. The chapters on column formulæ, highways, and timber are particularly good. There are numerous diagrams and illustrations scattered throughout the book, and not the least valuable pages are those containing an excellent index.

Hearings Before the Committee on Interstate Commerce, Senate of the United States, on Bills to Amend the Interstate Commerce Act, 1904 and 1905. Published by the Government Printing Office, at Washington, 1905, in five volumes; a total of 5,116 pages.

The Senate Committee has caused to be published the voluminous testimony on the subject of Federal regulation of railroad rates, and has included with the oral testimony the additional statements and documents filed with the committee. The result in the five volumes at hand is a stupendous collection of information on every side of the question of American railroad traffic relations between the shipper and the carrier. It is certainly not overstating the case to say

that no document of anything like equal importance in this field has ever been published heretofore. The work is well indexed, volume by volume, and the very fact that much of the testimony was of a character which would be inadmissible in an ordinary court trial because of remote relevancy to the subject adds vastly to the statistical and historical value of the work. The first volume, which contains 771 pages, contains the testimony of 15 men relating to the regulation of railroad rates, and of two others in regard to private car line systems. At the close of this testimony there is an appendix giving the current resolutions of state legislatures with regard to enlarging the powers of the Interstate Commerce Commission, and also resolutions from a large number of chambers of commerce and boards of trade. A second appendix contains a partial list of bonds and stocks of railroads held by savings bands, insurance companies and other institutions in 1900, and also an appendix containing bills introduced in the Fifty-eighth Congress relating to interstate commerce and to the Interstate Commerce Commission. The second volume continues the testimony with regard to railroad rates and concludes with a careful topical index and with a map showing lumber production and lumber territory in the United States. The third and fourth volumes conclude the testimony about railroad rates, including a vast amount of incidental information; while at the close of the fourth volume there is a consolidated index of the entire five volumes, divided topically and also giving a list of appendices and a list of authors. The fifth volume consists entirely of appendices, including the railroad laws of Canada, Great Britain and France; complaints before the Interstate Commerce Commission; inland port differential; briefs, report and opinion; interstate commerce statutes annotated and indexed; Federal courts and the orders of the Interstate Commerce Commission, and employers' liability laws of states and territories. These five volumes are not on sale, but can presumably be obtained through senators and members of congress, and they form an almost indispensable basis of a correct understanding of economic railroad conditions in the United States at the present time. If the agitation for Federal rate regulation has no other result, it will have gone far toward being justified in the production of this amount of light and understanding on a difficult and complex subject.

TRADE CATALOGUES.

Nickel Steel.—The International Nickel Co., 43 Exchange place, New York, has issued a neat booklet giving a long list of the purposes for which nickel steels have been successfully applied in the United States, France, Germany and England. The company points out that the addition of 3 to 4 per cent. of nickel in steel increases the proportional elastic limit, adds to the ductility of the steel, increases its resistance to compression, abrasion and shock, and increases its toughness, so that nickel steel is a safer material than carbon steel. A number of other interesting pamphlets are issued by the same company.

Lewis and Clark Exposition.—The Union Pacific has a booklet in folder form on the Lewis and Clark Exposition. It can serve as a pocket manual to visitors to the exposition, as it contains beside a map of the United States a large bird's-eye view map in colors of the exposition grounds with a directory, a map of Portland, half-tone illustrations of the exposition buildings, and general information about hotel rates, street car lines, etc. There is also a history of the Oregon country and information regarding its present condition, resources, prospects, etc., as well as descriptions of the exposition buildings. The book will be mailed upon receipt of a two-cent stamp.

Reinforced Concrete.—The St. Louis Expanded Metal Fireproofing Co., St. Louis, maker of corrugated bars for reinforced concrete, sends a folder containing an extract from the official proceedings of the International Railway Congress, in which it is stated that "railroad practice shows that carefully built reinforced concrete structures give excellent service and require almost no maintenance. For this reason the use of reinforced concrete should be recommended, even if the cost of construction should, exceptionally, be higher than for another system of construction."

The Chicago, Milwaukee & St. Paul includes in the literature being distributed by its passenger department three delightful little books on "Lake Lore," the Lewis and Clark Exposition, and its Chicago-Kansas City train, The Southwest Limited, respectively. The first is a vivid description by Forrest Crissey of "Lakeland," the northern lake resort region reached by the Chicago, Milwaukee & St. Paul. The nature of the contents of the other two is indicated by their titles.

Electric Grinders and Buffers.—The Northern Electrical Manufacturing Co., Madison, Wis., sends Bulletin 48 on Northern electric grinders and buffers. The bulletin is quite complete, illustrating by nice half-tone engravings the different styles of machines and their details and explains fully their construction, application and merits. Two interesting engravings at the front show respectively a Hindu grindstone and an ingenious dog-driven device used in California.

Railroad Shop Tools.—The July issue of the "Progress Reporter," published by the Niles-Bement-Pond Co., New York, contains a number of excellent full page illustrations of heavy machine tools used in the Angus shops of the Canadian Pacific Railway. Full page illustrations of the locomotive erecting and machine bays of the above shops are shown, and a brief description of the tools and the method of doing work at these shops is also given.

Friction Draft Gear.—The Gould Coupler Co., New York, is distributing a catalogue descriptive of its friction draft gears for passenger cars, freight cars and locomotives. Excellent illustrations in both line and half-tone are given, as well as diagrams showing the results of compression tests made at Cornell University. Illustrations and descriptions of the Gould friction buffer for passenger equipment are also given.

The Erie Railroad, through Luis Jackson, Industrial Commissioner, has issued an "industrial map" of the territory tributary to its lines. This shows in different colors the anthracite and bituminous coal areas, the areas in which oil or gas is produced and the regions which contain coal, oil and gas. A map of the Erie lines adjacent to New York is included.

Graphite.—The August number of *Graphite*, published by the Joseph Dixon Crucible Company, Jersey City, N. J., contains an interesting article on condensers, an extract from an address by Mr. James H. Reed on competition and salesmanship, and the usual number of brief suggestions for the use of graphite for many purposes.

Compressed Air.—The July issue of this magazine contains numerous interesting articles on the modern application of compressed air, including a description of the drainage system of the Interborough Rapid Transit Railroad tunnel under the Harlem River, the pumps for which are operated by compressed air.

Interurban Railway Construction.—J. G. White & Co., Engineers and Contractors, New York, send their interurban railway bulletin. It is handsomely illustrated throughout, with views showing work done by the company, in various stages of completion, including power houses, car barns, bridges, road construction, etc.

The Wachusett Dam of the Metropolitan Water Works.

BY GEORGE W. BLODGETT.

The substantial completion of the Wachusett Dam, at Clinton, Mass., which was begun in 1895, and has been carried on almost continuously ever since, marks an epoch in the history of the water supply of Boston, Mass., and the adjacent cities and towns. This great work was undertaken in accordance with an act of the legislature of Massachusetts, passed in 1895, by which the Metropolitan Water Board was created, "to construct, maintain and operate a system of Metropolitan waterworks, substantially in accordance with the plans and recommendations of the State Board of Health, contained in their report to the legislature for the year 1895," etc., etc.

For two years previously, the State Board of Health had been engaged in investigations for designing a system of water supply (as directed by an act of the legislature passed in 1893), for the "city of Boston and the cities and towns within a radius of ten miles of the state-house, and such other cities and towns, as in their opinion should be included in connection therewith." It presented a voluminous and comprehensive report in 1895, which led to the passage of the act above mentioned.

The dam is founded on solid rock, which, in the deepest part of the valley is about 60 ft. below the level of the then existing mill-pond. Borings were made every ten feet across the lower part of the valley, and every 20 ft. up and down stream, at the proposed site of the dam. The work was of such magnitude, and the preliminary investigations required were so many and so arduous, that although a large force of engineers were constantly at work, it was not until 1898, that the necessary surveys, etc., were so far completed that the Water Commissioners were able to announce that "the actual site of the proposed dam has been fixed." The contract for its construction was executed Oct. 1, 1900, and the date of Nov. 15, 1904 was fixed for the completion of the entire work, and the sum named in the contract is $1,603,635.

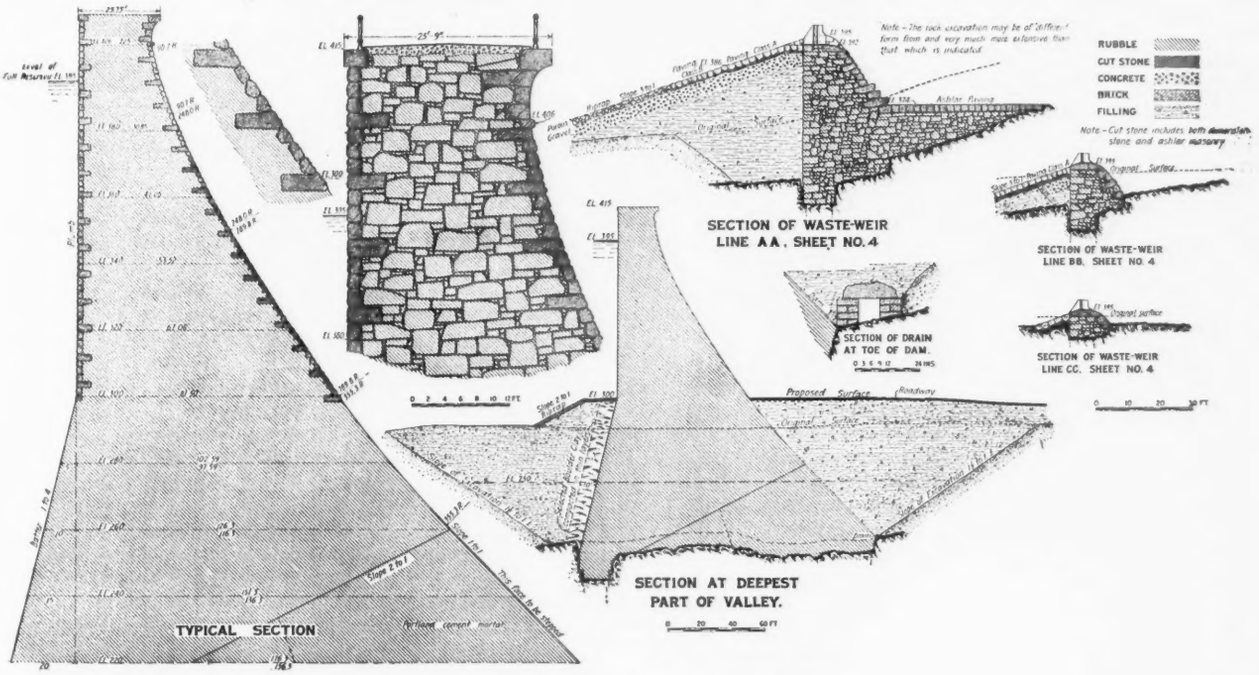
Besides the building of the great dam there was to be built a reservoir covering 6½ square miles of land, and a conduit 13½ miles long, partly tunnelled through rock, partly built of masonry, and partly an open channel following the course of an existing

brook, to carry the waters of the south branch of the Nashua river (on which the dam is located) to the storage basins and the conduits leading to Chestnut Hill Reservoir, the main distributing point for the city of Boston. (This was to be connected to other suitable reservoirs, adapted to furnish water to the other towns and cities within the metropolitan district.)

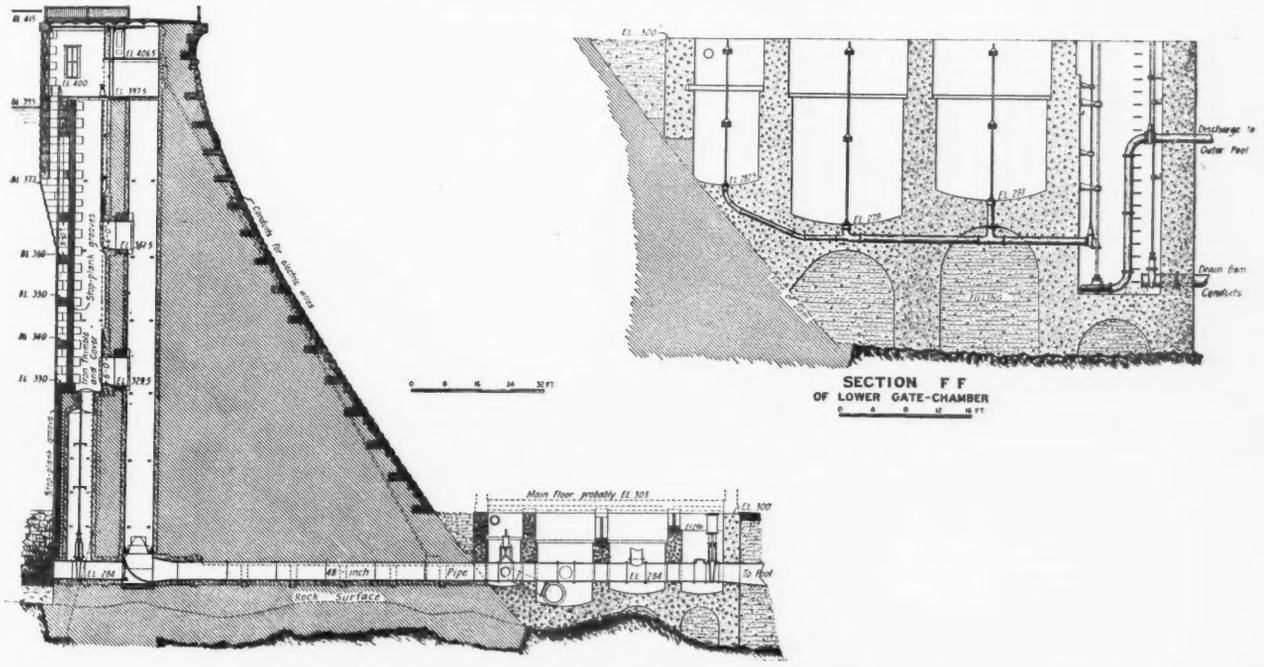
It was early seen that an increased supply of water would be needed before the dam could be completed, and it was determined to build the conduit as soon as possible, so that water might be turned into it when necessary, by a temporary connection with the river above the dam. As the tunnel would be the part of this conduit requiring the longest time for its completion, it was placed under contract as soon as the location and plans could be decided upon, and work was begun March 31, 1896.

A temporary dam was built above the site of the proposed main structure and a flume 7 ft. 2 in. wide x 7 ft. 7 in. high was made of timber and planks, to take water from the river above the temporary dam, into the tunnel and conduit below, so that the danger of a shortage of water in Boston was averted long before the building of the main dam had progressed so far that water could be stored behind it and discharged into the conduit in the manner finally arranged for. Water was turned into the conduit through this temporary connection March 7, 1898.

In order properly to build the great dam it was necessary to divert the waters of the river from their natural channel and carry them past the excavation for the foundations of the dam. This was done by means of a wooden flume 700 ft. long, 40 ft. wide and 16 ft. deep at the upper end and 13 ft. deep at the lower end, through which the water was carried and discharged into the river beyond another temporary dam built lower down, to prevent flooding the excavation by backwater from the river below. The main dam, as finally located, is at a point where the valley is 1,250 ft. wide at the level of high water in the reservoir, and the dam itself is 850 ft. long, and more than 200 ft. high at the deepest part of the gorge. The distance from the full water level of the reservoir to the rock at the downstream edge is 179 ft. At this upper level the masonry is 25 ft. thick, while 175 ft. below the thickness is 179.3 ft. It is much thicker and higher above the water than many masonry



Cross Sections through the Wachusett Dam.



Sections through Gate Chambers of the Wachusett Dam.

dams which have been built for the storage of water, partly to provide a very large factor of safety, where a failure might cause so large a loss of life and so great a destruction of property as here, and partly to provide for the thrust of the ice against the upper side of the dam when the reservoir is full and the weather is very cold for a long time. It has not been usual, the writer believes, to take account of this force, in the design of large masonry dams similar to this.

To provide the necessary stability under these conditions the height of the dam was increased 20 ft. above the full reservoir level, as it was found less masonry would be required if built in this manner, than to increase the thickness at the high-water level as much as would have been necessary. The rock on the northerly side of the gorge where the dam is built, consists of granite covered with a comparatively thin layer of sand or gravel; the southwesterly slope is composed of metamorphic slate or schist, with a layer of gravel over it 30 ft. deep above the level of the mill-pond, which formerly existed, and under the mill-pond, to a still greater depth.

The action of the water before the rocks were covered with earth eroded the softer schist to a much greater depth than the harder and more unyielding granite where the two come together, and this produced an abrupt wall of granite from 30 to 40 ft. high. The granite therefore extends to within a comparatively short distance of the surface, and advantage was taken of this circumstance to construct the waste-way of the dam at an elevation only a little above the original level of the rock on which it rests.

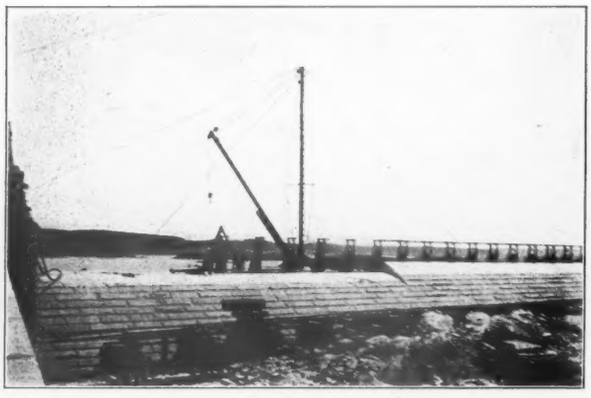
For the building of the main dam the earth and the rock itself were removed to a depth where the rock was firm and free from seams. The average depth of rock thus removed was 13 ft. A cut-off trench 20 ft. wide and 14 ft. deep was then excavated into the rock below this level, and a recess about 20 ft. deep was dug into the face of the granite cliff about 40 ft. high, formed by the junction of the schist rock with the granite as before mentioned. In order not to disturb the walls of this trench, 3-in. holes were drilled six inches apart on centers, along each side of the trench to the bottom of the excavation, and the rock in the center was taken out by blasting; what remained along the sides was then removed by driving large steel wedges into the holes; in this way the walls were usually left vertical and firm. The last portions of the rock in the bottom of the trench were removed by bars and wedges, and no blasting was allowed. The surface of the rock was washed clean with water before any masonry was laid.

The drawings show a section at the deepest part of the valley, also a typical section on a larger scale, and other sections.

In the cut-off trench, and the lower part of the dam, a triangular section for a distance of 150 ft. up stream from the toe, and 50 ft. high, is laid in Portland cement mortar mixed in the proportions of one part cement and two parts sand, and the beds of the stones in this portion were inclined upwards in the ratio of one vertical to four horizontal; above this point the inclination for a considerable further height is one vertical to six horizontal. Above the bottom of the excavation the proportions of the Portland cement mortar were one part cement to two-and-a-half parts sand. The remainder of the dam—except in cold weather—was built with natural cement mortar in the ratio of one part cement and two parts sand.

Except on the up-stream and down-stream faces the dam is composed of rubble masonry, consisting of large pieces of granite obtained from an excellent quarry on the reservoir property about 1½ miles up the river. These stones were quarried with a flat or slightly convex surface on the under side, and a bed was prepared for each stone by suitable small stones laid in cement, and all spaces between and around the large stones were filled in the same way, and all the joints filled with mortar, so that the whole is a solid mass of masonry. A facing of granite ashlar from 12 in. to 14 in. thick, obtained from Chelmsford, Mass., is laid on the up-stream and down-stream faces of the dam, partly to improve the appearance, and partly to better resist the action of frost. It is bonded with the rubble behind it by frequent headers extending well back into the mass. The down-stream face is a straight slope of 1:1 and is built in steps from the bottom of the excavation to a height of sixty feet; above this the face has a slight curve up to the finished grading of the ground; beyond this the radius is changed three times and gives a pleasing appearance to the finished work. On the up-stream face there is a batter of 1:4 from the bottom, which is at elevation 187 to elevation 300 (that is for 113 feet in height); above this point the up-stream face is vertical. The crest of the dam is at elevation 415, so that the entire height of masonry is 228 ft. There is a sharp curve near the top of the down-stream face, which causes it to overhang the lower portion, and gives it a bold and striking appearance. The coping stones on this side are anchored back into the masonry behind them by large steel rods. The top of the structure has a slightly rounded surface to give proper drainage, and is to have a granolithic finish. It will be surmounted by a handsome stone balustrade on each side.

At the northerly end of the dam proper is what is called the bastion, which is added, partly to give a finish to this end, and partly to afford convenient space for storage of the stop-planks for the spill-way. This is built of granite and concrete, and the ceiling is supported by steel "I"-beams, between which are slabs or panels of reinforced concrete. At the southerly end a somewhat similar structure called the "abutment" has been built. (The plan of both these is however rectangular, instead of circular, as originally designed and shown on the drawings.) One of the illustrations, from a recent photograph, shows the down-stream face, and another is a view of the up-stream side.



Crest of Up-Stream Face of Dam.

Down-Stream Face of Dam.

Water was at first drawn from the reservoir through four 48-in. pipes built into the masonry, near the bottom. A section through the gate chamber showing these is shown on one of the drawings. Two vertical wells are provided for each pipe, the upper one containing gates for regulating the flow, and the lower or down-stream one carries to each pipe the water which has passed through the gates. Sixty-eight feet below the level of the full reservoir and 43 ft. above the bottom of the 4-ft. pipes the up-stream well is divided by a horizontal diaphragm. The gate in the 4-ft. pipe is below this diaphragm, and was used during the construction of the dam, and while the water in the reservoir was at a low level, but is now permanently closed, although provision is made for opening these gates should it be desired to drain the reservoir to the bottom, or in case of an unprecedented flood, or of some emergency.

In the upper part of the upper well—which is still kept in use—are two gates, each 2½ ft. by 6 ft., one at the bottom and the other halfway up; the upper one has a head of 30 ft. of water behind it, and can be opened to fill the pipe and the lower well, and the lower gate can then be readily opened under the diminished head; it is, however, perfectly feasible to open the lower gate under the full head of 62 feet, should there be any occasion for so doing. The water now flows into each of the lower wells through six portals, each 8 ft. high and 2½ ft. wide, which have on the up-stream side coarse screens, and finer screens on the down-stream side, by which foreign substances which it is desired to exclude, can be prevented from entering the pipes. These gates, screens, etc., are operated from a room in the body of the dam above the wells, but which does not, however, extend to the top.

Below the dam is built the lower gatehouse, which serves also as a head-house for the Wachusett aqueduct, and later may be used as a power-house for utilizing the energy of the water flowing from the reservoir, by means of turbines and electric generators.

This structure is divided into a series of four wells for each four-foot pipe. The first of these is a dry well, and contains for each pipe, two 24-in. branches, each of which has a gate to regulate the flow of water into the aqueduct. These two-foot pipes discharge into a four-foot perforated pipe called a diffuser, located in the second well; the second and third wells contain the feed-pipes for the turbines (when these are installed), and the discharge pipes from the turbines. The fourth well is also commonly a dry well, and contains a gate in each of the four-foot pipes, which can be used to discharge water from these pipes directly into the pool below the dam. Also, if by accident the quantity of water passing from the reservoir should be greater than the capacity of the aqueduct the excess would overflow into this fourth well, and be carried thence by two 5-ft. pipes into the waste conduits and the pool. Each well is connected by a drainage pipe with a pump well at a lower level from which any drainage water is easily removed by a pump. Each waste pipe from the fourth well increases in diameter from the lower four-foot gate, until its reaches the size of eight feet 40 ft. from the well, and 10 feet a little farther on, where it connects with the masonry conduit leading to the pool; this diminishes the velocity of the water from 50 ft. per second to 12½ ft. at the end of the pipe, and 8 ft. at the end of the masonry. At the pool, 55 ft. diameter, the water is discharged through many openings in the bottom at a velocity of but four feet per second, corresponding to a head of but about three inches.

This pool is located in the middle of a larger one 150 ft. in diameter, with a waste way at the side farthest from the gate-house, 110 ft. long, from which the water falls about 8 ft. on an apron at the upper end of the river or mill-pond below. By the terms of the agreement with the Lancaster Mills Company, about one mile down the river, two million gallons per day of clean water are to be supplied to them, and hence at least this amount is allowed to flow through the pipes and conduits into the pool and the river below.

In freshets, and at some other times, there will be water to be wasted above the capacity of the pipes before mentioned. This will be taken care of by means of a spillway, which is 450 ft. long, and occupies the space between the end of the dam proper and the northerly shore of the reservoir. To obtain the necessary length it is carried up-stream at an angle with the dam for the greater part of the distance (the last hundred feet or so being at right angles to the shore), and is terminated by a small abutment of granite, from which a cut-off wall is built into the rock and into the bank beyond the abutment for a considerable distance.

The elevation of the top of the spillway for the greater part of its length is the same as that of the water in the full reservoir, but the first one hundred feet is at an elevation three feet lower. In times of freshet, therefore, the stop-planks can be removed and the rise of water partially or wholly checked, before any considerable depth passes over the remainder of the waste-way. The whole length will be provided with flashboards, mainly to prevent the loss of water by waves dashing over the crest, and with this in view the top has been made a plain surface, and dressed smooth after the top stones were in place, by pneumatic hammer.

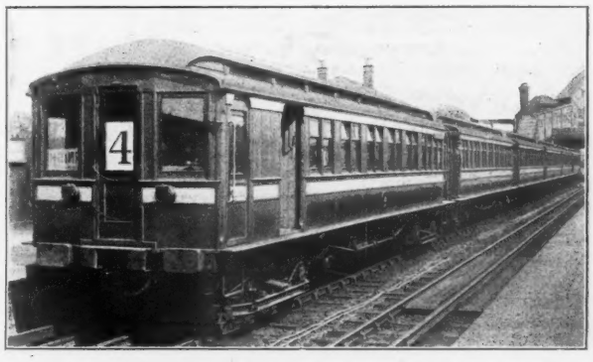
All the stop-planks can easily be removed when desired, from a foot-bridge which is being built 7 ft. above the crest of the waste-way, upon the iron standards which contain and support the grooves for the flashboards. Slope-paving is placed above the spill-way, at an angle of one vertical to three horizontals, and the crest of the spill-way is rounded and the down-stream side curved so as to cause the water to follow the masonry for the most part. The facing is of ashlar, and steps are built in the lowest part, to receive the impact of the falling water. The deepest part of the depression was filled with rubble masonry or Portland cement concrete.

With flashboards on the lower part of the spillway and a depth of 5 ft. on the whole of the crest, the spillway can discharge a quantity of water equal to 4.9 in. over the whole of the watershed above the dam. The greatest freshet in the valley of the Nashua river of which any account is obtainable occurred Feb. 13, 1900, while the dam was building, and was due to a rainfall lasting 37 hours, and averaging 3.18 in. over the whole watershed; the ground was frozen and largely covered with ice at this time, so that the greater part of the water found its way rapidly into the reservoir and the flume which had been built to carry the river over the excavation for the main dam, which was then in progress. This was taxed somewhat beyond its expected capacity (being calculated for a flow of 9,000 cu. ft. per second), as the maximum flow of water was 9,050 cu. ft. per second, but this maximum flow lasted only about two hrs., increasing and decreasing rapidly before and after this period; the total for 24 hrs. averaged 6,390 cu. ft. per second. In another freshet which occurred March 2, 1900, the maximum flow was 7,840 cu. ft. per second, which was produced by a rain of about 3.18 in. in 34 hours. Ample provision has therefore been made for the most unusual conditions likely to occur.

Below the waste-way a channel has been excavated through the earth and through rock averaging from 50 to 70 ft. wide and from 20 to 30 ft. deep, for about 800 ft. below the waste-way to the river below the dam. This channel may not be large enough to carry all the water flowing over the waste-weir in such freshets as occur about every 25 years, and almost certainly will not be sufficient for those which come once in about 100 years, but it will undoubtedly be cheaper to pay the damage that may be caused by the insufficient capacity of the channel than the extra cost of the construction necessary to enable it amply to meet these unusual conditions, which may not arise during the next century.

Electric Train Service on the London Metropolitan.

The electric train service installed last February on the St. John's Wood line of this company between Baker street, Harrow and Uxbridge, has proved to be quite successful from the standpoint of comfort and convenience of passengers. The accompanying illustration shows one of the six-car motor trains which are fine specimens of the car builder's art. Whether they are as profitable to operate as the old rolling stock used in steam trains, may be doubted however. They weigh more, cost more and seat fewer passengers than the old cars. The old six-car trains weighed 90 tons and seated 420, while the new trains weigh 150 tons and seat only 320. The cars were built by the Metropolitan Amalgamated Carriage & Wagon Company at its various works near Birmingham and Manchester. Two classes only are provided, the difference being in the nature of the upholstery on the seats. In the first-class compartments green "moquette" is used and in the third-class "buffalo hide," a patented imitation leather, but the seats in both classes are arranged in the same way and are of the same size so that if at any time it should be decided to have only one class, as in the tube railways, the change can be made with little expense.



Metropolitan Railway 6-Car Electric Train on the St. John's Wood Line.

The cars are exceptionally well lighted with electricity, there being four chandeliers in the roof of each car with three lamps each, and six single lamp brackets along each side above the windows. The roof lining is made of asbestos mill board painted white, which further assists the lighting effect. Deck sash ventilators are used and in addition a pivoted sash or transom is provided above each of the fixed side windows.

The seats in the trail cars are arranged in the same manner as in the cars of the Central London or "two-penny tube." There are six double cross-seats on each side in the middle of the car, holding 24 persons, and two side seats at each end, holding eight persons each, the seats being divided by low arms. This gives a seating capacity of 52 passengers in a car 52½ ft. long as against 80 in the old third-class cars, 42 ft. long. The motor cars seat 48, half in cross seats and half in longitudinal seats at one end only. They have a small baggage compartment with sliding doors on each side. A few spare parts are carried here for emergencies. The motorman's cab occupies the entire end of the car and has doors on each side and one in the end. This end door is intended for through communication only in case two motor compartments should be placed together in a train. Large windows on each side of the door provide an excellent lookout for the motorman.

The cars are mounted on two four-wheel trucks having pressed steel frames and 42-in. wheels. On each axle of the motor cars is mounted a 150-h.p. motor giving a total of 1,200 h.p. to a train made up of two motor cars and four trail cars. As the line is in many places on a 1¼ and 2 per cent. grade, ample power is necessary. The Westinghouse "turret" system of electro-pneumatic multiple unit control is used, as are the Westinghouse air-brakes. The motormen being as yet unused to their powerful action, considerable unpleasant jerking is experienced in making stops, but this will probably be overcome to a great degree in the future.

The service at present consists of trains between Baker street on the "Inner Circle" and West Hampstead, Willesden Green, Neasden, Wembley Park and Harrow. On week days trains leave Baker

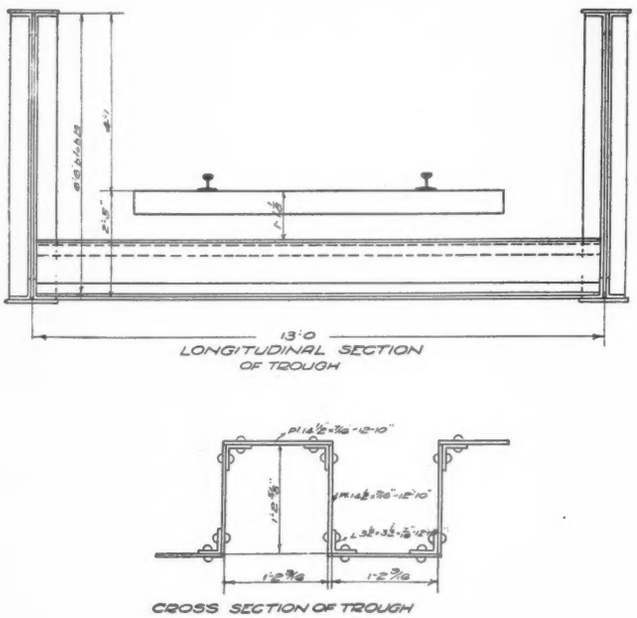
street from 2 p.m. to 11 p.m. at intervals of about 15 minutes except between 5 and 6 p.m., when they run every eight minutes. On Saturdays the service extends from noon to 11 p.m. with trains every 12 or 15 minutes, and on Sundays from 1 p.m. to 8 p.m., with trains every 15 minutes. Only one train an hour runs as far as Harrow.

Protecting and Water-Proofing Solid Floor Bridges.*

BY W. C. CUSHING,
Chief Engineer Maintenance of Way, Pennsylvania Lines, Southwest System.

The work of separating street and railroad grades in Chicago during the past 13 years has stimulated among railroad engineers the study of a suitable design for a bridge floor, which will be practically water-tight, and at the same time afford reasonable protection to the metal work of the structure, because the cost of reprotecting a ballasted solid-floor bridge is very large.

In the earlier days, when the Illinois Central became the pioneer of "track elevation," preparatory to the removal of the railroad track obstruction to the Columbian Exposition, the term "solid-floor" was considered synonymous with "shallow-floor," and the bridges were constructed with such floors till it was found to be practically impossible to comply with the conditions of water-tightness, steel



Bridge at Wright Street.

preservation and noiselessness. The latter condition has become a very important one, and has been a very considerable factor in the abolition of the shallow-floor, as it was necessary to put ballast between the cross-ties and the steelwork, in order to deaden the sound.

The change in style of construction has led to new problems in water-proofing and steel preservation, and it is the object of the writer to explain some of the plans used on the P., C., C. & St. L. at Brighton Park and Englewood, in 1904, while at the same time as clear a comparison of results as possible will be given.

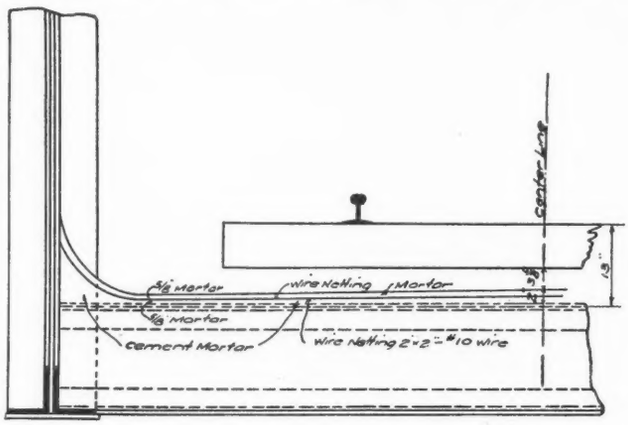
Each of the Brighton Park bridges at Thirty-fourth, Thirty-fifth and Thirty-sixth streets has nine tracks, as follows:

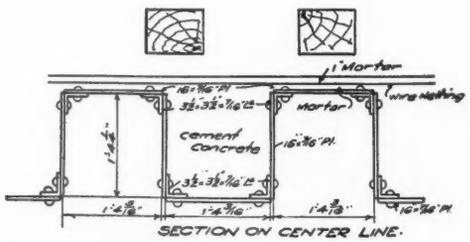
No. 1, No. 2, No. 3, No. 4	P., C., C. & St. L.
No. 5, No. 6	Chicago Terminal Transfer.
No. 7, No. 8, No. 9	Chicago Junction.

In type, they are half-through, single span, plate girders, 55 ft. long at Thirty-fourth street, and 71 ft. long at the other two, with a double track between each two girders, except in the case of Track 9.

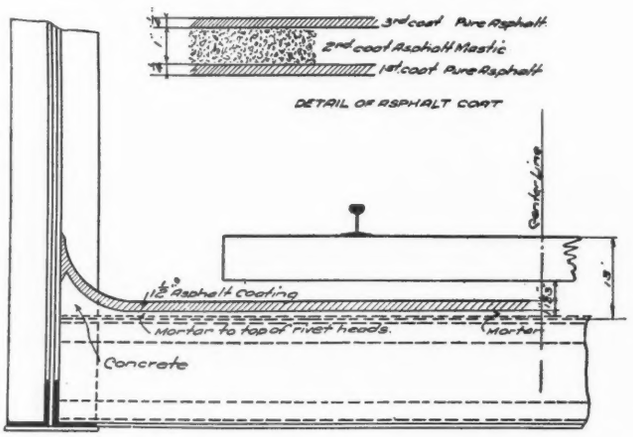
The floor system consists of 6-in. by 10-in. creosoted pine timbers laid closely together, parallel with the track, on the bottom flanges of heavy cross box-girder floor-beams. The drain water is carried through these box girders in 2-in. pipes, calked in like boiler tubes, and in gutters cut in the creosoted timbers, to the low end of the bridge back of the ballast wall.

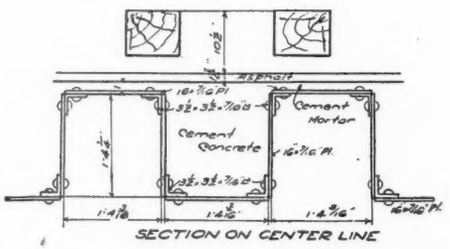
For tracks 1 and 2 a Portland cement mortar layer, 4½ in. thick at the center, and sloping to the drain pipes at the sides, where it is about 2 in. thick, was first laid on the creosoted timbers, the proportions used in the concrete being 1 cement to 5 torpedo sand, except at Thirty-fourth street, where it is 1 cement to 6 limestone screenings. Then, on this cement layer, and on the steelwork, a layer of hot asphalt was poured and swabbed on till it became a ½-in thick. The work was done very early in 1904, when the temperature was below freezing every night, and frequently during the day. Owing to conditions of construction, the time could not





Wire Netting Method at Archer Avenue.





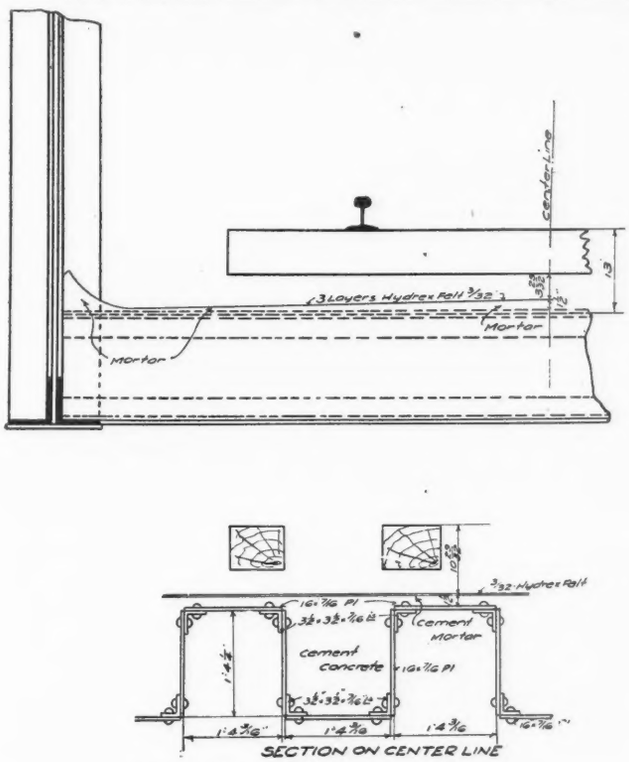
Asphalt Method at Archer Avenue.

*Reprinted from *Bulletin* No. 64 of the American Railway Engineering and Maintenance of Way Association, June, 1905.

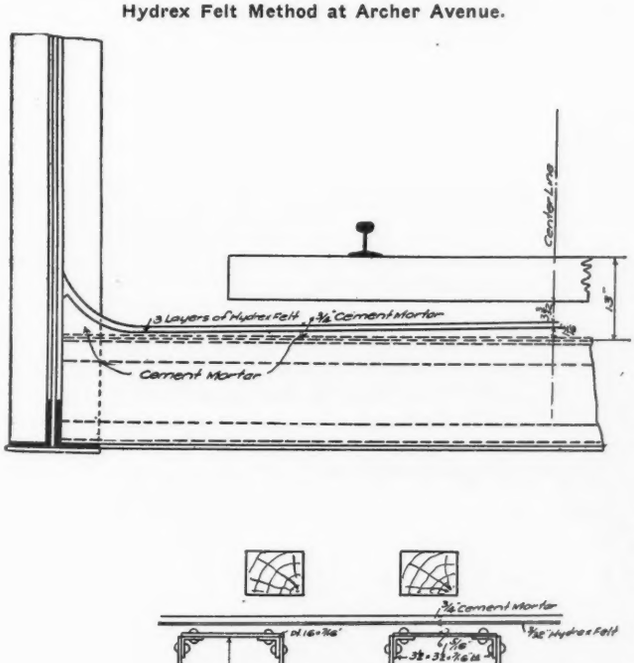
be chosen. The bridge erectors were waiting for the next bridge, and the work, therefore, had to be hurried. The asphalt did not adhere well to the cement, presumably on account of the moisture in the cement. Considerable difficulty was also experienced in getting the asphalt to adhere to the steel, on account of the shop coat of oil. An attempt was made to remove this coat by burning benzine, which was lightly poured over the oil, but with poor results. When the test was made by standing water on the bridges before use, they were all found to leak, principally around the pipes in the box girders, but were patched till entirely water-tight before being put in service under traffic.

Owing to the poor adhesion between the asphalt and the cement, it was decided for the next work, tracks 5, 6, 7, 8 and 9, to omit the cement, and substitute asphalt mastic. After considerable study, specifications for the asphalt were prepared, which, after some changes, finally took the form submitted in the appendix. The writer is indebted to Mr. W. H. Finley, then Principal Assistant Engineer of the Chicago & North-Western, for the matter contained in them. The asphalt was purchased under the specifications from different manufacturers, and, after receipt of a shipment, samples were taken to a testing laboratory and tested. The steelwork was first thoroughly cleaned with concentrated lye, and then painted with asphalt paint. A layer of pure asphalt gum ¼ in. thick was poured over the creosoted timbers and top of the steel box girders, and mopped on the sides of the latter till of the same thickness, after which a layer of asphalt mastic (made in the proportion of 1 asphalt to 4 of limestone screenings) was put on 4½ in. thick at the center and about 2 in. thick at the side drains. Finally, on top of all was poured a ¼-in. layer of pure asphalt, which, of course, had to be mopped on the sides of the girders. All of the bridges were made water-tight under test by patching where necessary. The work was performed in July and August.

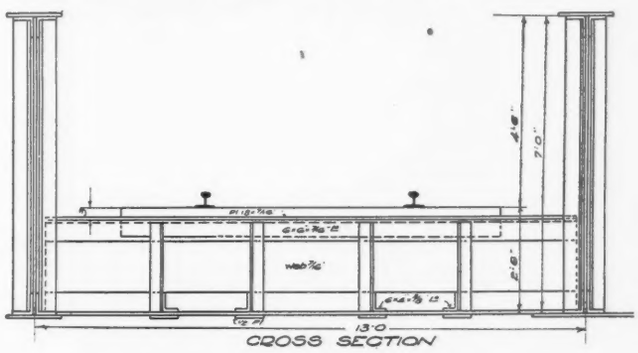
The difficulties experienced with the asphalt mastic at Englewood, which will be described later, and the good results from the protection for tracks 1 and 2, which were apparent after an inspection September 14th, succeeding a heavy rain, led to a return to the cement under-covering instead of asphalt mastic for tracks 3 and 4. A Portland cement concrete layer, 4 in. thick at the center, and about 2 in. thick at the side drains, in the proportions of 1 cement, 3 torpedo sand, and 3 crushed limestone broken to 1-in. size, except that at Thirty-fourth street the proportions were 1 cement to 6 limestone screenings, was placed on the creosoted timber and well troweled on top, to a smooth sidewalk finish, after which it was allowed to dry thoroughly. The steelwork was cleaned with concentrated lye and water, and the parts of steel and concrete intended to be covered with asphalt were painted with two coats of liquid asphalt, after which a ¼-in. layer of pure asphalt was poured on, then the asphalt mastic, in the proportions of 1 asphalt to 4 parts of sand and screenings, hot from the kettle, was packed and rammed, and the whole, including the box girders, covered with a finishing coat of pure gum asphalt, ¼-in. thick. The mastic was not carried over the tops of the box-girder floor-beams. The work was done in August and September.

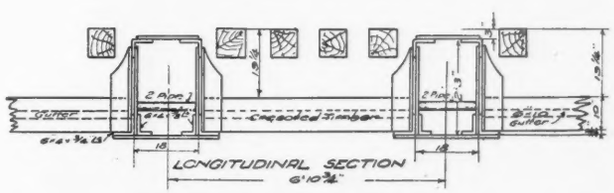


Hydrex Felt Method at Archer Avenue.



Hydrex Felt Method With Concrete on Top.





Thirty-fifth Street Bridge Floor.

The Englewood bridges are single-track, half-through plate-girder bridges of one span, each 72 ft. long, except that the Murray street bridge has two tracks, with three girders, while the one at Wallace street is a steel trough floor bridge 25 ft. long, with the troughs running parallel with the track. The floor systems of the other bridges are of the same type, except that the troughs are at right angles to the track. On account of the intention to add a second track to these bridges in the future, it was decided to use the asphalt mastic instead of concrete for filling the troughs, the latter being completely filled so as to carry the drain water to one or both ends of the bridge.

At Wright, Wallace and Lowe streets a ¼-in. layer of pure hot asphalt was poured all over the steel-work to be covered, mopping being resorted to in the case of vertical surfaces, and the troughs were then filled with hot asphalt mastic, mixed in the kettle in the proportions of 1 asphalt to 5 parts of sand and screenings. This mastic was carried over the tops of the troughs, crowned in the

center and sloped to the sides, which were built up in the form of gutters. On level track the gutters were sloped to each end of the bridge from the center. On the mastic was poured a ¼ to ⅜-in. layer of pure hot asphalt, over which, while hot, was scattered a ½-in. layer of clean gravel. It developed during the progress of the work that the mastic, while cooling, contracted, and pulled away from the sides of the troughs, but the cracks were filled again as completely as possible with the liquid asphalt. On test, when the work was completed, the bridges were water-tight, but, in the light of subsequent effects, the cooling must have continued, resulting in very fine cracks, which caused leaks.

At Murray and Union streets in order to avoid the contraction of the asphalt recited above, mastic blocks were molded in the proportions of 1 asphalt to 4 lime-stone screenings and allowed to cool. They were of such size as would just fit between the rivet heads of the troughs, and were set in place after the usual ¼-in. coat of pure asphalt had been put on the steel. The spaces were poured full of pure hot asphalt, but it was evident, during the pouring, that the cool blocks absorbed a good deal of the liquid, and it is considered possible that some voids remained near the bottom. The top was finished in the same manner as the other bridges. Subsequent results seem to indicate that the new method did not entirely correct the old.

The Brighton Park bridge at Archer avenue is a four-track, single span, half-through plate-girder bridge, of the P., C., C. & St. L. There is only one track between each two girders, which are 68 ft. long, and on skew. The floor system consists of square steel troughs, similar to the ones used on the Englewood bridges. Some new methods of waterproofing having been proposed, it was decided to try a different one for each track of this bridge, but in each case, the shop coat was removed with concentrated lye, at a cost of about 1 cent per sq. ft. of surface.

For track 1 the troughs were filled to the top with Portland cement concrete, mixed in the proportions of 1 cement, 3 torpedo sand, and 3 crushed stone, after which a galvanized wire netting of No. 10 wire, with 2-in. mesh, and costing 5 cents a sq. ft., was spread over the tops of the troughs, so as to rest on the rivet heads. This was then covered with cement mortar, mixed with 1 cement to 3 sand, 2 in. thick in the center, and sloping to the sides, where it is about 1¼ in. thick, thus allowing the water to drain to the sides, and thence to one end, as the bridge is on grade.

For track 2 the troughs were filled with Portland cement concrete, as above, except that it was carried above the troughs, crowned at the center and sloped to the sides. A pocket was made at the top edges, where they joined the main girders, and the surface was troweled to a sidewalk finish. On this were placed three layers of Hydrex felt, laid transversely with the track, and lapped like shingles, with 12 in. exposure, starting at the lower end of the bridge. The Hydrex is a patent saturated felt, made by Hydrex Felt & Engineering Co., in rolls 36 in. wide, and about 66 ft. long. Before placing, the concrete is swabbed with hot "Hydrex Compound," and the felt then smoothed down on it. The felt is turned into the pocket at the girders, and the cavity filled with the "compound." On top of the felt a ¾-in. layer of cement mortar was placed to prevent the puncturing by ballast of the waterproof felt covering. It was laid in blocks and troweled as in sidewalk work.

For track 3 the same method was used as for track 2, except that the top layer of concrete was omitted. This is to determine whether the Hydrex felt will be punctured by the stone ballast or not.

For track 4 the concrete filling was carried up to the top of the rivet heads, except that the surface was sloped from the center to the sides, and on it was placed a 1½-in. layer of asphalt. This was made by first painting the dry concrete surface with liquid asphalt, made of asphalt and benzine, after which hot asphalt was poured on to a depth of ¼ in. The liquid layer was followed by 1 in. of asphalt mastic, in the proportions of 1 asphalt to 4 limestone screenings, and this by another ¼-in. liquid layer, on top of which torpedo sand was sprinkled to harden the top.

The P., F. W. & C. bridges at Fifty-first and Forty-seventh streets are steel trough floor bridges, square in section, and supported parallel with the tracks on transverse girders, standing on columns on the curb lines, and in the center of the streets, a total clear length of 68 ft., in two 11-ft. sidewalk spans, and two 23-ft. roadway spans. For the first track, the troughs were filled with asphalt mastic without either painting the steelwork, or pouring on a coat of pure asphalt; this being done at the expressed wish of one of the asphalt manufacturers, who was given charge of this to do in the best way he could recommend. The mastic, mixed in the proportions of 1 asphalt, 3 torpedo sand, and 2 limestone screenings, was built up to 2 or 3 in. over the tops of the troughs, the center being higher, and the surface sloping to each end of the bridge. On top, a layer of pure asphalt gum ¼ to ⅜-in. thick was poured, and then sprinkled with sand to harden it. On test, immediately after its completion, the bridge was found to leak badly. It developed during the progress of the work that the shrinkage of the asphalt when cooling was such as to leave the metal practically unprotected, and the method was abandoned.

The bridges for the remaining tracks, 10 in number, and for Forty-seventh street, were done as follows: The steelwork, after being cleaned, was painted with hot asphalt and benzine, and ¼-in. layer of hot asphalt poured on and thoroughly mopped over, after which the troughs were filled to within about 3 in. of the top with cement concrete in the proportions of 1 cement to 6 limestone screenings. When this was thoroughly set and dry, the remaining depth of the troughs was filled with asphalt mastic, which was carried over their tops in a layer 2 to 3 in. thick, somewhat thicker at the center than at the ends, and this was in turn covered with a ¼ to ⅜-in. thickness of pure gum.

There are six different bridges at Fifty-first street. No attempt was made to remove the shop coat of oil from Nos. 1 and 2, and on No. 3 most of the experiments for removing the shop coat, which will be described later, were tried, after it was decided to paint the steelwork of the remaining bridges with liquid asphalt, without removing the shop coat.

The Forty-sixth street bridge is a four-track half-through plate-girder bridge with a steel trough floor like that at Archer avenue. All the troughs were filled with Portland cement concrete made in the proportion of 1 cement to 5 parts of limestone screenings. At track 3, the concrete was carried up over the tops of the troughs, and a finishing coat of asphalt was put on.

Tracks 1 (the most easterly one) and 2 and 4 were finished in the same manner as at Archer avenue, but the depth from bottom of tie to top of trough, about 8 in., is greater at Forty-sixth street and permitted a greater thickness of mortar layer on top of the troughs, 3 in., with the wire netting in the center. This top layer of mortar was composed of 1 cement to 2 parts of limestone screenings.

RESULTS OF EXAMINATION MADE ABOUT JAN. 1, 1905.

Brighton Park Bridges.—Archer avenue: No indications of leaks on any of the bridges. Thirty-fourth, Thirty-fifth and Thirty-sixth streets: Leaks showed plainly at every track of each bridge, but tracks 3 and 4 showed the fewest. The asphalt examined when the temperature was about 0 deg. Fahr. showed it be to hard, glassy, and easily shattered by a blow.

Englewood Bridges.—Every bridge, with the single exception of the one at Wallace street, showed leaks along the girders. As the troughs are practically water-tight, the only place where leaks can show is at the junction point between trough and girder, but it does not prove that the water finds it way down between the asphalt and the girder; it may occur at any other point, but the drip will always show on the girder line.

P., F. W. & C. Bridges.—All the bridges at Fifty-first and Forty-seventh streets showed leaks at the post lines, because the concrete, as well as the asphalt, cracked at those places, on account of lack of steel reinforcement. One bridge protected with asphalt was not put into service for several weeks after completion, but there was no difference in the result. At Forty-sixth street, up to the time of the inspection, the bridges for tracks 1 and 4 seem to be water-proof, but that at track 2, done late in the fall, showed leaks. The top layer of the concrete, in which the wire netting was imbedded, froze during the work, which may be responsible for the trouble. At track 3, where a concrete filling with asphalt top was used, leaks appeared along the girders, which may have been due to the asphalt pulling away from the girders.

GENERAL INFORMATION AND COMMENTS.

From the start difficulty was experienced in obtaining a satisfactory adhesion of the asphalt to the steel. As soon as it became cold, it could be peeled off like paper. After a good deal of experimenting it was found that asphalt would adhere to steel in about the following order:

(1) Rusty steel; no adhesion.

(2) Shop coat of red lead or oil; slight adhesion.

(3) Shop coat covered with liquid asphalt; slightly better than 2.

(4) Shop coat burned by pouring benzine over the steel and burning it; about the same as 3.

(5) Perfectly clean bright steel; excellent adhesion.

In order to have the fifth condition, a sand blast is probably necessary, but as there was none available, other means of removing the shop coat were resorted to. The bridges had all been given a shop coat of oil, and on some parts, red lead. The usual wire brushes and scrapers were expensive to use, and not satisfactory.

Burning benzine over the shop coat had little effect on the oil, except to soften it. It, therefore, required a number of repeated burnings to remove it entirely, which was expensive.

A paint burner, similar to the Buckeye burner and Wells light, was tried to a small extent, but it was slow, on account of being necessary to concentrate the flame on a small area in order to soften the oil sufficiently to be easily removed with scrapers. It was thought when this burner was made that the heat would be great enough to burn off the oil coat completely, without scraping, but it did not prove to be the case.

Cleaning with concentrated lye and lime was tried at Fifty-first street with good results, so far as removing the shop coat was

concerned, but it was found so difficult to remove entirely the lime and lye from the steelwork that the method was given up as impracticable. The lime stuck to the steel in spite of the frequent washings, and small particles would lodge in uneven surfaces around the rivet heads, where it was next to impossible to remove it.

The best results were obtained by using concentrated lye and water, in the proportions of 1 pound of lye to 1½ gallons of water. This solution was swabbed on the steel, wire brushes and scrapers were then used, and finally the steel was thoroughly washed until all the lye had disappeared. The cost was about 1 cent per sq. ft. of surface.

After the above methods were tried, and it was found that pretty good adhesion between the asphalt and metal was obtained by painting over the shop coat with liquid asphalt made by pouring hot asphalt into benzine, or obtaining it from the manufacturer, this plan was generally followed. When the liquid asphalt was applied, the benzine evaporated, leaving a thin layer of asphalt on the steel. A pretty thick mixture was used, and after applying two coats, the layer was about $^1/_{16}$-in. thick.

As it was desirable to purchase asphalt in a competitive market, the specifications in the appendix were prepared, and the orders were based on the manufacturer's agreement to comply with them. Samples were then taken and sent to a testing laboratory for determination of qualities. The requirements were purposely made severe, as the office the asphalt had to perform was severe.

The product of only one of three concerns fulfilled specification No. 1, the volatile test, while all stood the acid test. All but one sample did not flow at 212 deg. Fahr. and that one did so only at 196 deg. Fahr. At 15 deg. Fahr. below zero, about half the samples were brittle and one-half were not. This was a very severe requirement, coupled with a high temperature flow point. The requirement for supporting power, No. 7 (b), 15 lbs. per sq. in. at 130 deg. Fahr., was made because the provision for depth of ballast between the bottom of the tie and the asphalt was small, and there would be great danger of pressing the ballast through the asphalt if too soft. All of the mastic tested stood this requirement.

When one track at a time was being done, the force required was about 12 men and a foreman. It took the time of three or four of them to keep up fires, cut wood, and cut asphalt, while the rest were busy heating sand and screenings, mixing mastic, and depositing it in place, and painting, cleaning, etc. When there were several bridges to be done, seven or eight more men were necessary to clean and paint the next one ready for the asphalt.

The equipment for one gang was as follows:

		Each.
1	Asphalt heater 3 bbls. capacity	$62.50
1	Mastic heater	105.00
2	Sand and screening heaters	20.00
	Shovels, spuds for stirring mastic, brooms, wire brushes, smoothing irons	.....
2	Pay-off pails	5.00
1	Dipper	2.00

The asphalt mastic mixer was 8 ft. long, and had doors for firing at one end and on both sides. Anything longer was found to be impracticable. The sand heaters were made of sheet iron.

During the progress of the work, the cost of asphalt fell from $60 to $40 and even $35 per ton, due to the competition. This, as well as other matters, caused the unit price to vary considerably. The information is presented in Table A.

Table A.—Brighton Park.

	Track No.	Price of asphalt, pr ton.	Area bridge, sq.ft.	Total cost.	Cost per sq.ft.	Protection.
34th St.	1 & 2	60	1,581	$403.28	$0.255	Concrete bottom; asphalt top.
	3 & 4	40	1,581	309.11	.195	
	5 & 6	40	1,430	294.78	.206	All asphalt.
	7, 8 & 9	40	2,145	356.23	.167*	All asphalt.
35th St.	1 & 2	60	2,041	501.64	.246	Concrete bottom; asphalt top.
	3 & 4	40	2,041	344.05	.168	
	5 & 6	40	1,846	361.60	.196	All asphalt.
	7, 8 & 9	35	2,769	610.82	.220	All asphalt.
36th St.	1 & 2	60	2,041	456.27	.223	Concrete bottom; asphalt top.
	3 & 4	40	2,041	335.46	.164	
	5 & 6	40	1,846	440.19	.238	All asphalt.
	7, 8 & 9	†35 & 60	2,769	665.95	.240	All asphalt.
Archer Ave.	1	..	871	326.78	.375	Conc.; wire mesh
	2	..	871	366.78	.420	Hydrex., con. top.
	3	..	871	366.78	.420	Hydrex. on con.
	4	40	871	370.36	.425	Con. bot.,asp. top.
	Streets.					
Englewood	Wright.	35	936	295.34	.316	All asphalt.
	Wallace.	35	486.5	165.89	.341	"
	Lowe.	35	936	305.32	.326	"
	Union.	40	936	515.60	.550	"
	Murray.	40	2,376	1,526.98	.642	"
	P., F. W. & C. Railway.					
	Bridge No.					
46th St.	1	..	520	175.69	.338	Concrete and wire mesh.
	2	..	520	144.92	.279	
	3	40	520	226.72	.435	Concrete, asphalt
	4	..	520	176.50	.439	Conc.; wire mesh
47th St.	..	40	5,531	1,976.61	.357	Con. bot.,asp. top.
51st St.	1	35	3,349	1,414.45	.422	All asphalt.
	2	35	2,292	850.09	.370	Concrete bottom; asphalt top.
	3	..	2,074	754.10	.360	
	4	40	2,278	785.70	.344	
	5	40	2,156	604.76	.280	
	6	40	2,521	913.69	.362	

*The cost on this bridge is low, due to fact that considerable material was used which was furnished by asphalt company by mistake, for which no charge was made.

†6,102 tons at $35; 2.85 tons at $60.

Archer Ave.: Track No. 1, Eastbound freight; No. 2, Eastbound passenger; No. 3, West bound passenger; No. 4, Westbound freight.

CONCLUSIONS.

(1) Asphalt mastic is not suitable for filling the troughs of solid floor bridges, because of its shrinkage when cooling, thus defeating the objects of its use, protection of the steel, and the formation of a solid, compact mass, with such close adherence to the steel as to be water-tight. It is felt that ample trial was made of it, and that, too, with different mixtures of the best asphalt to be found. The advice of the manufacturers or dealers was freely accepted, till it was discovered that they were simply experimenting as well as ourselves.

(2) It is quite within reason to consider, in the light of the tests, that an asphalt covering next below the ballast, either over mastic or concrete, is not an efficient water-proof coating. When the inspection was made in January only one bridge (track 4 at Archer avenue), prepared with this, was not leaking, but it is entirely reasonable to doubt that it is the asphalt rather than the concrete which is performing the satisfactory service. The requirements of ductility and hardness conflict. When the asphalt is made soft enough to resist tearing apart under temperature changes, it is too soft to bear the load of traffic, a fact which has been also proved on other railroads. It is impossible to provide for a sufficient depth of ballast to overcome this objection.

(3) Ordinary concrete has not sufficient strength in itself to resist the forces tending to tear it apart at the column lines of bridges in two or more spans. Consequently leaks developed at every place of that kind. Although it has not been proved by trial, it is quite likely that reinforced concrete will prove effective, and it will probably be tried this year.

(4) Concrete is an effective filling material for troughs, because it adheres firmly to the steel, protects it from corrosion, and can be made practically water-tight, either by the use of concrete rich in mortar, or by a solution of soft soap and alum.

Its objections are that it is:

(a) Difficult to remove in case repairs are necessary, or in view of the replacement of, or addition to, the bridge, on account of constant improvements in the property.

(b) Heavy, and adds considerable dead weight to the bridge.

(c) Costly, on account of the quantity, and the great care necessary to make a satisfactory job.

(5) Something more than filling the troughs is necessary, however. A top surface is required, graded to carry the water to the sides and to the ends of the bridge. Concrete alone is not suitable, unless in considerable thickness. To meet this condition, it must be reinforced. Nothing definite in regard to the woven wire mesh used at Archer avenue has yet transpired, because the track, No. 1, where it was used, has not yet been put in service for traffic. Similar construction at Forty-sixth street on the Pittsburg, Fort Wayne & Chicago, was effective up to January, except in the case where the concrete was frozen. The writer is inclined to favor the use of small rods, from ¼ to ⅝-in. thick, rather than the wire, on account of making better use of the steel, and, quite likely, greater economy.

(6) The Hydrex felt covering, track No. 3, at Archer avenue, has as yet given no cause for complaint, but this is a case where time is especially needed to determine the result, because its effectiveness depends on its strength against puncture by the ballast, which is a very thin layer under the ties. It has been much used by the Chicago & Western Indiana.

(7) If, however, the Hydrex felt should be broken up by the ballast, there is a remedy, where there is a sufficient depth of ballast, by laying a concrete sidewalk on top of it, as at track 2, Archer avenue, to bear the loads transmitted by the rolling stock. This concrete need not be waterproof.

(8) In the case of trough floors transverse with the tracks, there seems to be no help for it except to fill them up with a rich concrete, unless indeed a drain hole is cut in each, and a gutter underneath be provided, a plan which should not be resorted to except in case of necessity for a long bridge. After this is done, one has the choice of several different ways for providing a waterproof covering.

(9) When the troughs are placed parallel with the track, a much less thickness of concrete filling can be used, if a suitable method for protecting the portions of the troughs sticking up above the concrete can be devised. It is quite certain, where columns are used, that the concrete must be reinforced at the column lines, and other expansion places. If a plaster of cement is put over the ex-

posed troughs, it may possibly have to be reinforced also, on account of its thinness.

The work described in the foregoing was performed under the direction of Mr. N. Neff, Engineer Maintenance of Way, and his assistant, Mr. C. L. Barnaby, Chicago Terminal Division, and they also furnished the data for the compilation of this article.

APPENDIX.

Pennsylvania Lines West of Pittsburg—Southwest System.

Specifications and Instructions for Water-Proofing Metal and Masonry Structures.

I. *Pure Gum Asphalt.*—1. Asphalt shall be used which is of the best grade, free from coal tar or turpentine, and which will not volatilize more than one-half of 1 per cent. under a temperature of 450 deg. Fahr., for 10 hours.

2. It must not be affected by a 20 per cent. solution of ammonia, a 25 per cent. solution of sulphuric acid, a 35 per cent. solution of muriatic acid, nor by a saturated solution of sodium chloride.

3. (a) For metallic structures exposed to the direct rays of the sun, the asphalt should now flow under 212 deg. Fahr., and should not become brittle at 15 deg. Fahr. below 0 deg. when spread in a layer ⅛-in. thick on thin glass.

(b) For structures underground, such as masonry arches, abutments, retaining walls, foundation walls of buildings, subways, etc., a flow point of 185 deg. Fahr. and a brittle point of 0 deg. Fahr. will be required.

II. *Preparation of Surface of Structure.*—4. (a) Before applying the asphalt to a metal surface, it is imperative that the metal be cleaned of all rust, loose scale and dirt; and, if previously coated with oil, this must be entirely removed. When the asphalting is done during the summer months, between May and September, the clean, dry metal shall be painted with two coats of cold asphalt paint, free from oil, made by thinning pure gum asphalt with benzine, before the hot asphalt is applied. When the asphalting is done during the winter months, this coating will be omitted, but the metal shall be warmed to the satisfaction of the engineer, before the hot asphalt is poured on. The warming is best accomplished by covering the metal with hot sand, which should be swept back as the hot asphalt is applied.

(b) When water-proofing masonry structures, if the surface cannot be made dry and warm, it should be first coated with the asphalt paint applied cold. This is particularly necessary for vertical surfaces.

III. *Application of Coating.*—5. The asphalt should be heated in a suitable kettle to a temperature not exceeding 450 deg. Fahr. If the temperature should run above 450 deg. Fahr., for any length of time, it will result in "pitching" the asphalt. Before the "pitching" point is reached, the vapor from the kettle is of a bluish tinge, which changes to a yellowish tinge after the danger point is passed. The asphalt has been sufficiently cooked when a piece of wood can be put in and withdrawn without the asphalt clinging to it.

6. (a) The first coat shall consist of a layer not less than ¼ in. thick of pure asphalt poured from buckets on the prepared surface and thoroughly mopped over.

(b) The second coat shall consist of a mixture of clean sand or screenings, free from earthy admixtures, previously heated and dried, and asphalt, in the proportion of 1 asphalt to 3 of sand or screenings by volume; this is to be thoroughly mixed in the kettle and then spread out on the surface with warm smoothing irons, such as are used in laying asphalt streets.

(c) The third or finishing coat shall consist of pure hot asphalt spread evenly in a layer not less than ¼ in. thick over the entire surface, and then sprinkled with washed roofing gravel, torpedo sand, or stone screenings, to harden the top.

7. (a) The built-up thickness of the three coatings described in Section 5 should be 1½ in. at the thinnest place for steel bridges and 2 in. for masonry arch bridges.

(b) This built-up asphalt covering must not perceptibly indent when at a temperature of 130 deg. Fahr., under a load at the rate of 15 lbs. per sq. in., and it must remain ductile at a temperature of 15 deg. Fahr. below zero on metal structures, and at 0 deg. Fahr. on masonry structures under ground.

IV. *Concrete Filler.*—8. In the case of steel trough floors, the trough will first be filled with Portland cement concrete, mixed in the proportions of 1 cement, 3 sand and 3 broken stone, and the surface will be finished 1½ in. below and to the same shape as the asphalt surface. The concrete is to be placed against the clean steel, free from rust, oil, paint or dirt. A plan for drainage may be necessary in each case, because that is affected by the length and grade of bridge and by the direction of the troughs.

The long Orenburg & Tashkend Railroad, which gives an all-rail route from the Russian provinces of Central Asia to European Russia, is to be opened for regular traffic July 14. The length of the line is about a thousand miles. There are to be three trains a week for the present, which will run through in four days.

Table for Calculating Cubical Contents of Piling.

The accompanying table for calculating the cubical contents of piling was gotten out by Mr. E. O. Faulkner, Manager Tie and Timber Department of the Atchison, Topeka & Santa Fe. It is based on the prismoidal formula, the instructions for its use being as follows: Find the diameter of each end of the pile by taking the mean of the longest and one at right angles thereto, in each case working to the nearest half inch. Multiply the tabular number corresponding to the large and small diameter of each pile by its length in feet.

Table for Calculating Cubical Contents of Piling.

Large diam. (inches)	Small diameters (in inches.) 6.	6½.	7.	7½.	8.	8½.	9.	9½.	10.	10½.	11.	11½.	12.	12½.	13.
8 in.	0.27	0.29	0.31	0.33	...	...	...	...	...	...	...	...	...	...	...
8½ "	.29	.31	.33	.35	0.37	...	...	...	...	...	...	...	...	...	...
9 "	.31	.33	.35	.37	.39	0.42	...	...	...	...	...	...	...	...	...
9½ "	.33	.35	.37	.40	.42	.44	0.47	...	...	...	...	...	...	...	...
10 "	.36	.38	.40	.42	.44	.47	.49	0.52	...	...	...	...	...	...	...
10½ "	.38	.40	.42	.45	.47	.49	.52	.54	0.57	...	...	...	...	...	...
11 "	.41	.43	.45	.47	.50	.52	.55	.57	.60	0.63	...	...	...	...	...
11½ "	.43	.45	.48	.50	.52	.55	.58	.60	.63	.66	0.69	...	...	...	...
12 "	.46	.48	.50	.53	.55	.58	.61	.63	.66	.69	.72	0.75	...	...	...
12½ "	.49	.51	.53	.56	.58	.61	.64	.66	.69	.72	.75	.78	0.82	...	...
13 "	.52	.54	.56	.59	.61	.64	.67	.69	.72	.75	.79	.82	.85	0.89	...
13½ "	.55	.57	.59	.62	.64	.67	.70	.73	.76	.79	.81	.85	.89	.92	0.96
14 "	.58	.60	.62	.65	.68	.70	.73	.76	.79	.82	.86	.89	.92	.96	.99
14½ "	.61	.63	.66	.68	.71	.74	.77	.80	.83	.86	.90	.93	.96	1.00	1.03
15 "	.64	.66	.69	.72	.74	.77	.80	.83	.86	.90	.93	.96	1.00	1.03	1.07
15½ "	.67	.70	.72	.75	.78	.81	.84	.87	.90	.93	.97	1.00	1.04	1.07	1.11
16 "	.71	.73	.76	.79	.81	.84	.87	.91	.94	.97	1.01	1.04	1.08	1.11	1.15
16½ "	.74	.77	.79	.82	.85	.88	.91	.94	.98	1.01	1.04	1.08	1.12	1.15	1.19
17 "	.78	.80	.83	.86	.89	.92	.95	.98	1.02	1.05	1.08	1.12	1.16	1.19	1.23
17½ "	.81	.84	.87	.90	.93	.96	.99	1.02	1.06	1.09	1.13	1.16	1.20	1.24	1.28
18 "	.85	.88	.91	.94	.97	1.00	1.03	1.06	1.10	1.13	1.17	1.21	1.24	1.28	1.32
18½ "	.89	.92	.95	.98	1.01	1.04	1.07	1.11	1.14	1.18	1.21	1.25	1.29	1.33	1.37
19 "	.93	.96	.99	1.02	1.05	1.08	1.11	1.15	1.18	1.22	1.26	1.29	1.33	1.37	1.41
19½ "	.97	1.00	1.03	1.06	1.09	1.12	1.16	1.19	1.23	1.26	1.30	1.34	1.38	1.42	1.46
20 "	1.01	1.04	1.07	1.10	1.13	1.17	1.20	1.24	1.27	1.31	1.35	1.39	1.43	1.47	1.51

The State Railroad Commissions.

In 1903, as its first brief in its campaign for increased powers, the Interstate Commerce Commission issued an elaborate statistical report on state regulation of railroads. This showed that in 1890 there were 28 state railroad commissions. This number increased to 30 in 1902 (after the adjournment of the state legislatures). Six states which in 1890 were without commissions established them during this period, although subsequently two of these states abolished their commissions. Four states which in 1890 had commissions abolished them before 1902, but in two cases subsequently re-established them. The Interstate Commerce Commission classifies railroad commissions as "strong" and "weak," calling a commission "strong" when it has rate-making power and "weak" when it has no such power. Of the 28 commissions existing in 1890, 15 were "strong" and 13 were "weak"; while of the 30 existing in 1902, 20 were "strong" and 10 were "weak." Of the eight commissions established or re-established during the period, all but one were "strong," showing a very general tendency to give such bodies power over rates. Since 1902 one commission, in Colorado, has been abolished and three new commissions, in Indiana, Washington and Wisconsin, have been established, all of these three this year. There are therefore now in existence, 32 state railroad commissions. The Colorado commission which was abolished was a "weak" commission. The Indiana, Washington and Wisconsin commissions are all "strong." Thus of the 32 now existing, 23 commissions are "strong" and nine "weak" against 20 "strong" and 10 "weak" in 1902. Evidently the tendency toward "strong" commissions which was exhibited up to 1903 has been continued until the present time. The situation is shown in the accompanying table:

State Railroad Commissions, 1905.

State.	Present Com. founded.	Powers.	State.	Present Com. founded.	Powers.
Alabama	1881	Strong.	Mississippi	1884	Strong.
Arkansas	1893	Strong.	Missouri.	1875	Strong.
California	1876	Strong.	N. Hampshire .	1844	Strong.
Connecticut ...	1853	Weak.	New York.	1883	Weak.
Florida	1897	Strong.	North Carolina.	1891	Strong.
Georgia	1879	Strong.	North Dakota .	1889	Strong.
Illinois	1871	Strong.	Ohio.	1867	Weak.
Indiana	1905	Strong.	Rhode Island ..	1872	Weak.
Iowa	1878	Strong.	South Carolina.	1878	Strong.
Kansas	1901	Strong.	South Dakota .	1889	Strong.
Kentucky	1880	Weak.	Tennessee	1897	Strong.
Louisiana	1898	Strong.	Texas.	1891	Strong.
Maine.	1858	Strong.	Vermont	1855	Weak.
Massachusetts .	1869	Weak.	Virginia	1877	Weak.
Michigan	1873	Weak.	Washington ...	1905	Strong.
Minnesota	1871	Strong.	Wisconsin.	1905	Strong.

The Indiana Commission was created by the Newhouse bill, which was approved by the Governor on February 28 and became a law on April 15. The appointment and official term of the Indiana Commission began on May 1, when it organized with Union B. Hunt, Chairman and William J. Wood and C. V. McAdams as the other commissioners. The commissioners receive a salary of $4,000 a year and serve for four years. The commission has general power to supervise traffic and adopt necessary regulations to govern car and train service. It has power upon the filing of complaint to investigate rates, to set aside existing rates and substitute other

rates therefor. Such rates are to go into effect upon the order of the commission, unless suspended upon appeal to the Appellate Court. In the event of appeal a bond is to be executed by the railroad company or companies involved which shall provide for repayment to shippers of the difference between the two rates in case the decision of the commission is affirmed by the Appellate Court. If the commission's decision is not affirmed, the old rate remains in force and the bonds are void. The commission also has power over switching charges, the location and maintenance of side tracks, and crossings of railroads with other railroads and with electric lines; and has much to do with the physical conditions of railroads. The provisions of the railroad commission law apply also to express companies doing business in the state. Besides all this, the commission has power to inquire into interstate traffic. If this is being carried on in violation of the Interstate Commerce law demand is to be made by the commission upon the transportation company to comply with that law. On the transportation company's failure to comply with this demand, application can be made by the Indiana commission to the Interstate Commerce Commission for relief.

The Washington Commission was created by the Crane-Dickson bill, which passed the Senate by a vote of 36 to 4, and as amended by the Senate, passed the House by a vote of 71 to 10. The law went into effect on June 7 and the commission was organized on June 23, with H. A. Fairchild, who was appointed for a term of six years, Chairman; John S. McMillin (term of four years), and John C. Lawrence (term of two years), as the other two Commissioners. The regular term of office is six years and the salary is $4,000 a year. The commission has power to fix freight rates within the State of Washington, subject to review by the courts on appeal. It may alter an existing rate when, sitting as a board of arbitration or inquiry, it finds that such rate is unjust. If the railroads dissent, they may appeal to the Superior Court of Thurston County (Olympia), in which the case takes precedence of any on the calendar. The commission sits as a board of arbitration when complaint is made of an unjust or discriminatory rate, and as a board of inquiry when it investigates a rate on its own motion or initiative. It has authority, through the courts, to enforce its own orders. It may, when the railroads fail to agree, make joint rates. It may summon any railroad official or employee as a witness, and may compel the attendance of witnesses. It also has the right to call for the records and books of a railroad company. Under the railroad commission law every railroad is expressly prohibited from charging more for a shorter than for a longer haul over the same line and in the same direction when the shorter is included in the longer distance.

The Wisconsin commission, which was discussed in the *Railroad Gazette* of June 23, page 716, though classed as a "strong" body, has rate-reviewing rather than rate-making powers. Rates can be attacked only after 10 days' notice and altered only after due hearing and investigation. Changes then ordered by the commission are to go into effect pending appeal. Under the Railroad Commission law the railroads may alter existing rates as often as they like, provided the proposed changes are published 10 days beforehand and the commission is notified of the change and does not take steps to show it unreasonable. Wisconsin has in the past had a single railroad commissioner, elected every two years, with a salary of $3,000, and with very limited power. The new commission is to consist of three members with salaries of $5,000 a year each and a regular term of six years. The members of the commission are Professor B. H. Meyer, of the University of Wisconsin; Halford Erickson, Commissioner of Labor and Industrial Statistics, and John Baines, a lawyer. It is provided in the railroad commission law that one commissioner shall have a general knowledge of railroad law and each of the others a general understanding of matters relating to railroad transportation. No person appointed a commissioner may be pecuniarily interested in any railroad, either in, or outside of, Wisconsin. Both the commissioners and the secretary are prohibited from holding any other position while in office.

Besides these three states in which new railroad commissions have actually been established, the legislature of Nebraska at its recent session provided for what might be called a potential commission, which will perhaps be established in 1906. The Cady bill, which passed both houses of the legislature and received the Governor's approval, proposes an amendment to the constitution of the state which reads as follows: "There shall be a State Railway Commission, consisting of three members, whose terms of office, except those chosen at the first election under these provisions, shall be three years, and whose salaries shall be $3,000 each per annum. Of the three commissioners first elected, the one receiving the highest number of votes, shall hold his office three years, the next highest two years, and the lowest one year. The powers and duties of such commission shall include such regulation of rates, service and general control of common carriers as the legislature shall provide by law." The constitutional amendment provided for in this bill is to be voted on at the general election on Nov. 8, 1906. Although this proposal gives to the people the decision as to whether or not there shall be any railroad commission at all, it reserves to the legislature the extremely important right of practically fixing the duties and powers of the commission, if created; and this not only at the time of its appointment but at any time in the future when the legislature shall see fit to contract or expand the commission's powers.

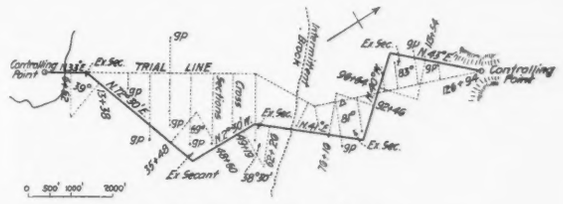
The recently established commissions have many points of similarity. All three would be classed by the Interstate Commerce Commission as "strong." In determining their powers the precedent of the "weak" but eminently successful Massachusetts commission has been entirely disregarded. Apparently the people, or the legislatures, of Indiana, Washington and Wisconsin feel that more good can be accomplished by a railroad commission with positive power than by a body which compels obedience not by constituted authority but by the prestige of its own impartial observation. It will be interesting to observe how far this belief is justified.

Locating a Railroad Line Through a Forest.

BY J. A. MACDONALD.

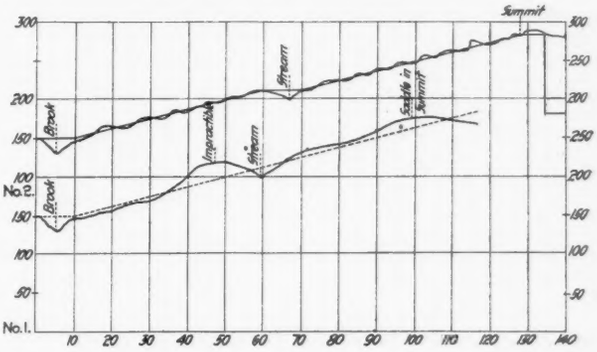
In easy country, running a line through a forest is but little more difficult than running a line over a prairie, a gang of axemen doing the only additional work. But in rough and difficult country locating a good line through a thick forest is perhaps as hard a problem as the locating engineer is likely to meet with. The writer was recently engaged in a survey of this kind on a line 15 miles long through virgin forest for most of the distance with only occasional vistas of open country.

Where the land was fairly level comparatively no difficulty was experienced. Township maps were made and with the assistance



Plan of Located Line.

of the local inhabitants the latitudes were easily obtained, but on coming to deep valleys and high ridges much trouble was encountered. Often it answered to back up one or two stations on coming to very high or very low ground and turn an angle to get around the difficulty but there were places where half a dozen back-ups would not have aided in getting a good location. Backing up is a poor way of getting on with a railroad location although it is frequently necessary in running a line through thick forest. The aneroid barometer and pocket compass are essential for this kind



Profile of Trial Line and Final Location.

of work and save much trouble in crossing ridges and summits and in starting and arriving at controlling points.

In this article will be described the method of getting from one controlling point to another which was the summit of the line on a ridge about two miles distant. Exploring ahead from the starting point the aneroid showed that the lowest available crossing point on the ridge was between 120 and 150 ft. higher than the controlling point two miles back. As the limit of grade was 1.25 per cent. this did not in itself seem a formidable difficulty but midway between was another ridge or more properly a table, the elevation of which it was difficult to accurately determine with the aneroid. Furthermore the ground on top of this intermediate ridge was wet and swampy, and covered with a thick growth of scrub spruce. It was

therefore decided to traverse the line by as direct a course as could be obtained from the maps on hand. These maps were made from compass surveys for the owners of the lands at various times, and could not be relied upon as strictly accurate. However, the controlling point on the summit ridge was located as accurately as possible on the maps and also the starting controlling point. An angle of 65 deg. turned to the left appeared to approximately answer the desired course at the starting point, and this course was followed until the intermediate ridge was reached, levels being taken at each chain. As it was of importance to cross the summit ridge at the controlling point previously located, a back course was started from that point, levels being taken as before. On reaching a point about where the first course was stopped it was found that the back course was about 1,000 ft. to the east. This, however, did not matter, and the two courses were joined by a direct line. This done, the levels were plotted on the profile and correct elevations obtained. The trial line profile is shown as the lower line on the accompanying plot, and it is a rough looking line indeed. The deepest cutting to grade meant going down 35 ft. in the swamp on the ridge and this, of course, was impracticable.

The next step was to cross-section the trial line with transit and level, running out on either or both sides of the course until grade level was reached. The grade assumed was the maximum and this was drawn on the profile. These cross-sections were taken every 500 ft. or 1,000 ft., and a grade line was drawn on the plan through these grade points. This line was necessarily very circuitous and was in reality nothing more than a grade contour line which would hardly answer for railroad location. After plotting this grade contour line on the plan the final location was drawn in. This was a compromise between the trial line and the grade contour line. The courses of the final location line were ascertained from the map with scale and protractor, and the line started. It was not always possible to keep on the precise course as determined from the plot, but the line was kept as closely to the course as the typography of the land would admit. This finally located line is shown as the heavy line on the plan. On developing the profile it proved to be a very good line as will be seen from the upper profile. On account of avoiding the swamp on the intermediate ridge it was necessary to develop the final course 2,800 ft. longer than the air line between controlling points.

The South African Railroad System.

Through the courtesy of Mr. W. W. Hoy, Chief Traffic Manager, we have received an early copy of the report of the Central South African Railways for the year ending Dec. 31, 1904. Railroad history in South Africa has to be taken and understood as a whole before the statements of any of its principal component roads are of great interest or value. South African railroads have been undergoing a development not unlike that which took place in the American West in the '70s and '80s, and it is well worth while to digress a moment from the report at hand to consider the general railroad position of that part of the African Continent that is dominated by Great Britain and by British influence.

The first railroad built in South Africa was in Natal, out of Durban as far as the Point, which was opened in 1860; but what might be called the main stem of the South African railroad systems is the system of lines comprising the Cape Government Railways in Cape Colony. When the Cape Colony lines were taken over by the British Government, in 1873, there was a railroad mileage of 63 miles, from Cape Town to Wellington via Stellenbosch and Wynberg, all part of what is now known as the Western System. Extensions were made rapidly. In 1875 the Western System, which now extends in a general northeasterly direction across Cape Colony along the boundaries of the Orange River Colony and the Transvaal to a connection with the Rhodesian Railways, had in all 103 miles of road built on the way to Kimberly, and a beginning had been made of the Eastern System out of East London, running northwest towards the Orange river, which separates what was then the Orange Free State from Cape Colony. In 1876, the first bit of the Midland System of the Cape Government Railways was built out of Port Elizabeth, extending directly north, likewise in the direction of the Orange river. Thus in that year there were well defined beginnings of the three present main stems of the Cape Government system—the Western, Midland, and Eastern—all of which start along the southern coast, while the two outer lines incline in towards the inner until they are connected up either directly or by spur lines in the vicinity of the Orange river. In that year the total mileage in the government system was 247. Ten years after that, it had increased, in 1886, to a total of 1,598, of which 717 was in the Western System, 589 was in the Eastern System and 291 in the Midland. This mileage remained practically the same for several years, but further important increases were made in 1890 and in 1892. The mileage in 1892 amounted to 1,890 miles and underwent little change from that time until after the Boer war.

The Cape Government Railways may be described as comprising substantially the entire railroad system of Cape Colony. The Western System, as already mentioned, now connects with the Rhodesia System at Mafeking, about 125 miles north of the Vaal river in British Bechuanaland. The Midland and Eastern systems both depend for their most important through traffic on their connections with the Central South African System. This system was formerly practically limited by the boundaries of the Orange Free State. It will be recollected that the Orange River Colony, as it is now known, was called the Orange Free State from 1854 until 1900, when it was annexed by Great Britain after joining in the Boer invasion of neighboring British territory. The present system of Central South African Railways was built by the Cape Government Railways as the northern part of that company's system, commencing with the extension to Bloemfontein in 1900. They were rapidly extended north as far as Viljoens Drift, near the Vaal river, where a connection was made over the lines of the Netherlands Company to Johannesburg and Pretoria, in 1902. The total mileage of this northern division in 1892 was 360, and the entire division was made up of what was practically a bee line across the center of the Orange Free State in a northeasterly direction from the Orange river to the Vaal river with only one branch, which was the spur from Springfontein to the Orange river at Bethulie, 27 miles. The former arrangement was that the Orange Free State should receive a certain share of the profits accruing to the Cape Government Railways from the operation of this important connecting link between their lines and the chief traffic centers of the up-country; but on Jan. 1, 1897, the Orange Free State bought the lines outright for £2,501,040, for which it issued securities and gave as first payment the share received from the earnings. At that time, in 1897, the gross earnings of this portion of the system (now the Central South African Railways) were £2,347 per mile, and working expenses were £951; so that the lines earned 29.8 per cent. on their capital stock as issued to the Orange Free State. Extensions were then rapidly undertaken and there can be no better evidence of the way the country was growing than to say that in those prosperous times, when great dividends were being earned, passenger traffic amounted to 29.3 per cent. of the total earnings. In other words, the lines were crowded, and were reaching out as rapidly as possible.

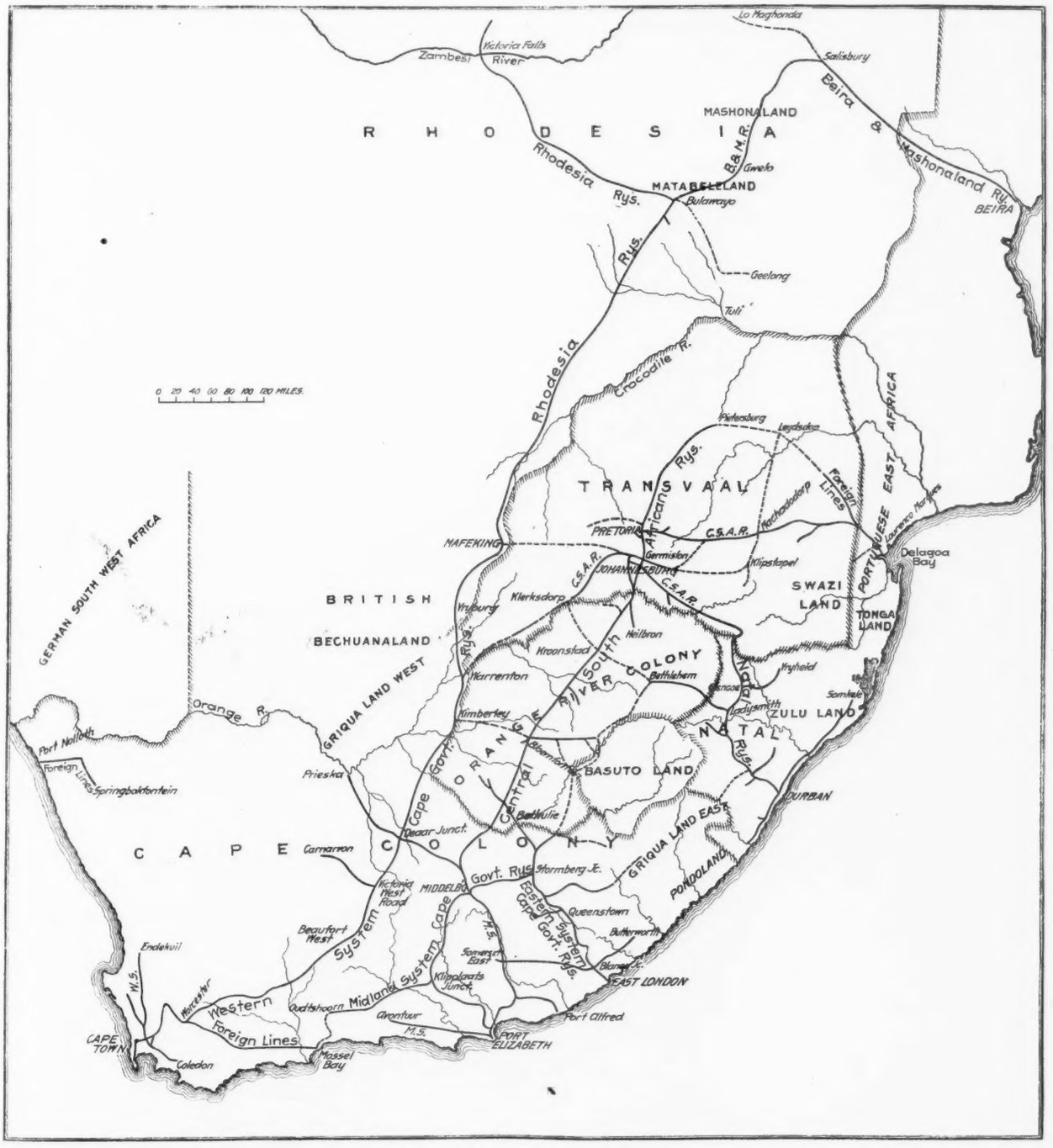
At the time of the Boer war, in 1899, the railroad map of South Africa showed the Cape Government Railways, joining at Vryburg the Bechuanaland Railway to Bulawayo, almost due northeast, and at two or three other points joining the Orange Free State Railways, which ran from connections with the Midland and Eastern systems of the Cape Government Railways on the Orange river, through Bloemfontein, the capital of the state, to Viljoens Drift on the Vaal river, where they connected with the lines of the Netherlands Company. The Netherlands lines aggregated 717 miles, and connected up important traffic centers, with their lines to Pretoria, Johannesburg, Krugersdorp, Elandsfontein, Vereeniging and the Springs. On the east coast, the Natal system, comprising the railroads of Natal and Zululand, had some 500 miles open at the time of the war, from the port of Durban to the Transvaal at Volkrust. There was also an important line known as the Beira Railway in the extreme northeast, which ran from the Port Beira in Portuguese East Africa across into Mashonaland, formed under the auspices of the Chartered Company, headed by Cecil Rhodes, in July, 1892, to make a connection with the Mashonaland Railway and the Beira Junction Railway through from Salisbury, Mashonaland, to the sea, at Beira, Portuguese East Africa. At the time of the war the Bechuanaland Railway, which was formed in May, 1893, to build from Vryburg northward to the Zambesi, and which reached Bulawayo, 579 miles from Vryburg, in October, 1897, was worked by the Cape Government at cost as part of the Cape system, and the company was to receive for 10 years a subsidy of £20,000 per year from the Imperial Government and £10,000 per year from the Chartered Company.

After the war, there was a radical re-arrangement of these properties. The Bechuanaland Railway became the Rhodesia system, which also now included a branch reaching out toward Victoria Falls, northwest of Bulawayo, and a branch on the northeast to Gwelo, where a connection was made with the Beira system. The lines in the Orange Free State and the Netherlands Company lines in the Transvaal had made plenty of trouble during the war, until they were seized by the British Government and operated under the name of the Imperial Military Railways. After the close of the war, when the name of the Orange Free State had been changed to Orange River Colony, its railway system and the Netherlands Railway system besides, were thrown together under the name of the Central South African Railways, and it is this company, strategically and geographically, the center of the South African system, that now makes its report.

The mileage of this system, reckoning the integral parts which did not formerly belong to it, was 1,109 in 1898; 1,367 in 1903; 1,432 in 1904, and 1,540 at the beginning of 1905. Its present status is that it connects with the Midland System of the Cape Government Railways at Norvals Pont, near the Orange river, at the bor-

der between Cape Colony and the Orange River Colony; with the Natal Railways at Brackwal in Natal, and at Charlestown on the borders of Swazi Land, and with the foreign line running out of Delago Bay from Lourenço Marques at Komati Poort in the Swazi Land border of the Transvaal. All traffic to Pretoria, Johannesburg, Machadodorp, Vereeniging, Kroonstad and Bloemfontein must pass over the Central South African Railways.

The lines are 3 ft. 6 in. gage, which is standard of the South African system. Their physical characteristics are those of heavy grades and curves. Much of the system may fairly be compared



The South African Railroad System.

to the Denver & Rio Grande, in this country. There is a heavy traffic in both directions, and the lines are thoroughly modern in their equipment and in their management. Nineteen hundred and four was a bad traffic year and severe retrenchment was undertaken, but the extensions were nevertheless continued, reaching out primarily towards more traffic connections with the Western and with the Rhodesia part of the South African system, and also into the northern country. Gross earnings (£4,587,778) amounted to 12s. 4.4d. per train mile. Expenditure amounted to 7s. 9.3d. per train mile, and net earnings to 4s. 7.1d. per train mile. Passenger traffic was about a third of the total. The characteristic of the operation has been to improve the lines and to reduce freight rates, so that the added mileage of the haul has not materially increased the earnings, at least not proportionately. As with most railroads, coal constituted much the heaviest traffic. Next in order came general merchandise; railroad stores, goods conveyed at military rates, grain and cereals and timber. The manager says in his report that whatever else the British occupation may or may not have done, one distinguishing feature is that, taking the year 1898, the last normal year before the war, and 1904, two years after the war, the internal trade of the Transvaal and Orange River Colonies has increased itself by nearly two-thirds, excluding coal, bricks, other minerals and railway material. It is rather surprising to the American reader to learn that the company has under consideration the electrification of one of its suburban lines in order to handle the heavy passenger traffic.

The heaviest through business in South Africa, both passenger and freight, is that between Cape Town and Johannesburg; a joint traffic over the Midland System of the Cape Government Railways and the lines of the Central South African Railways. The main line

in the Orange River Colony has been relaid with 80-lb. rails and a through passenger service, in limited trains, is now carried three hours faster than it was formerly on the inland journey, and one hour and a half faster on the coastward trip. The running time from Cape Town to Johannesburg is 45¾ hours and the down trip is made in 45 hours (1,014 miles).

A year or so ago, a writer in one of the British economic magazines pointed out that there was ample need for new construction in the Transvaal region. This was formerly prevented, in large measure, by the restrictive treaty between the late governments of the South African Republic and the Orange Free State. By this convention the Transvaal agreed not to make railroad extensions westward except with the consent of the Orange government. This was done, of course, to conserve the through traffic of the Free State lines. But with Federated South Africa, a federated system of railroads was at once feasible and desirable, and the complex scheme of extensions shown on the accompanying map has been planned with that in view.

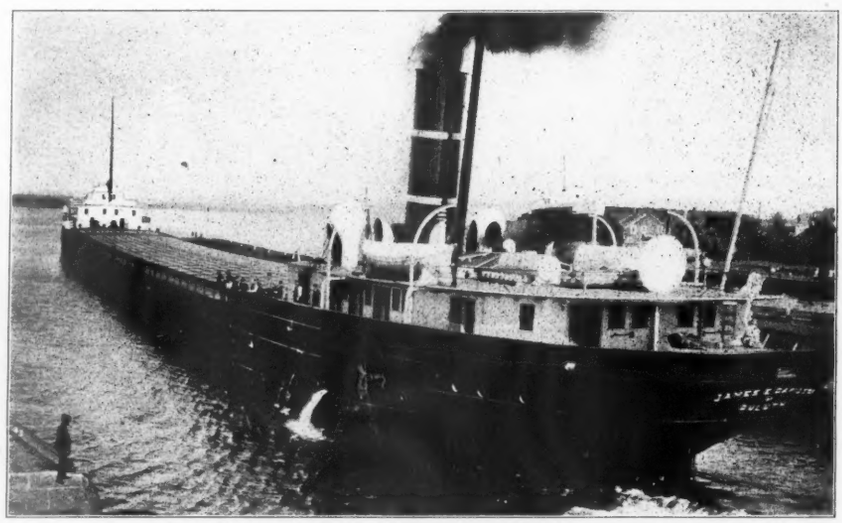
The New Fleet on the Great Lakes.

BY RALPH D. WILLIAMS.
Editor of the *Marine Review*.

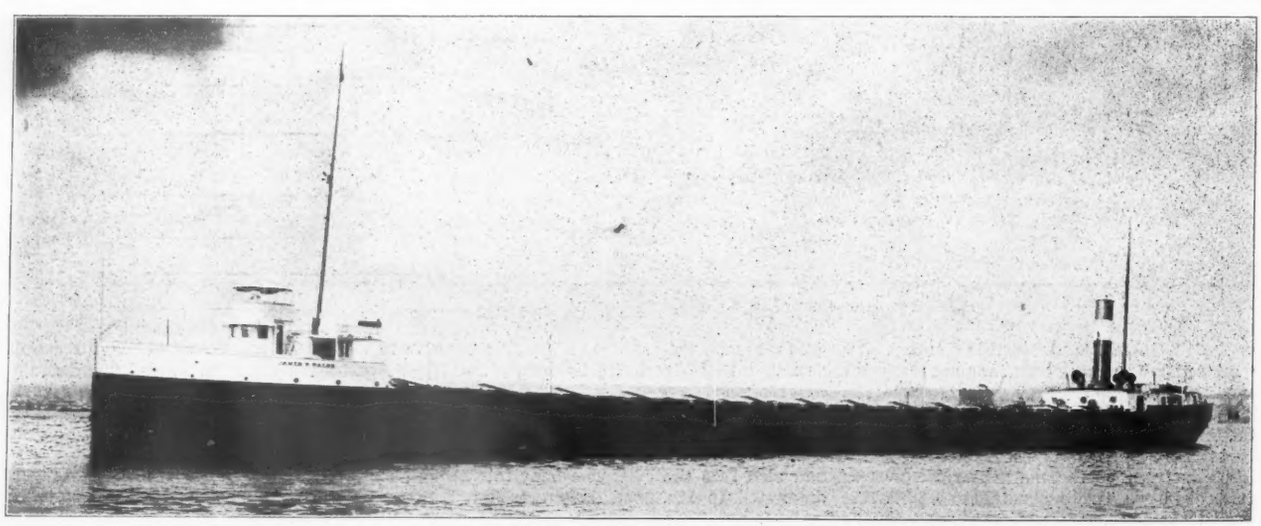
Never in the history of the business have the shipyards of the Great Lakes enjoyed the prosperity that they are now enjoying. At the beginning of the present year there were 47 ships of all classes building on the Great Lakes, of which 22 were bulk freight carriers and three were package freight carriers. It is interesting to note, as showing the rapid growth of the business of the bulk freight carrier, that the 22 steamers building at the beginning of the year could carry 226,000 tons of ore on a single trip, as against 230,000 tons of ore which could be carried in a single trip by 40 steamers that were building two years ago. In other words, in two years' time the carrying capacity of the lake freighter has nearly doubled, such has been the increase in mean dimensions. The 22 ships building at the beginning of the year, if confined to the ore trade exclusively, could move in a single season approximately 4,500,000 tons of ore. In addition to this work actually scheduled at the beginning of the year, the shipyards had orders to lengthen seven existing vessels by 72 ft. each. As a commentary on these lengthening orders it is interesting to add further that one of these ships was launched only three years ago. The purpose of lengthening these ships was to minimize the discrepancy which exists between them and the latest design of ore freight carrier.

A significant feature of this building program is the fact that the United States Steel Corporation, which has the largest fleet of vessels on the Great Lakes, gave orders for the construction of four ships exceeding in dimensions anything on the Lakes. These ships are 569 ft. over all, 549 ft. keel, 56 ft. beam and 31 ft. deep, and have a carrying capacity of well over 10,000 tons of ore. These are the first orders that the Steel Corporation has placed with the Lake shipyards since the corporation was formed. Coincident with the placing of these orders it offered for sale 16 of its smaller ships. These have now all been sold. They were all of them of the whaleback variety and their combined carrying capacity was no greater than the four new ships mentioned.

Such a building program ought to satisfy the most ravenous shipbuilder, but the end is by no means yet. By the first of June orders had been placed with the Lake shipyards for 17 additional vessels for delivery in the spring of 1906. Never before in the history of the Lakes have orders been given for ships a year ahead. That 17 such orders should be placed would have been beyond belief a year ago. It merely emphasizes the manner in which the trade of the Great Lakes is growing. As a rule, orders are not placed until fall for spring delivery, at which time trade for the following year may be fairly well gaged. Of the 17 ships for 1906 delivery, one of them is of 6,500 tons capacity, two of 8,000 tons capacity, five of 9,000 tons capacity, and the balance of 10,000 tons capacity and over. The average carrying capacity of all the ships now building for delivery during the present year and next year is a trifle over 9,000 tons, proving conclusively that the ore trade of the Great Lakes, which is, of course, the dominating trade, is gravitating inevitably to the big ship. The new ships now under order and dropping off the stocks can move in a single trip 370,500 tons of ore. In a full season they can move 7,220,000 tons of ore. In other words, this year's new crop of ships could move almost the entire ore commerce of the Great Lakes even as late as 1894, when 7,748,000 tons of ore were brought down the lakes. Any single one of these ships could have moved the entire ore commerce of the Great Lakes even so late as 1865, when 236,000 tons of ore were shipped from the upper lake ports. The movement of ore for the present year is predicted at 30,000,000 tons, and will safely approximate that figure. The vessel capacity on the



James E. Davidson, 524 ft. Long, Great Lakes Engineering Works.



James P. Walsh, Built by Craig Shipbuilding Co., Toledo—500 ft. Over All.

Great Lakes, however, must now be equivalent to a movement of 45,000,000 tons, showing that the smaller class of vessels must inevitably seek some other trade than the ore trade.

What will become of these smaller vessels is a problem, as the lumber trade is a dying trade, and neither grain nor coal can be depended upon in the same manner that ore can. The freight rate has been hammered down so low that there is practically no money in the ore trade for the small ship. The operating expenses of a 10,000-ton steamer are not much greater than those of a 3,000-ton steamer, while the former can carry more than three times as much cargo. As illustrative of this, the steamer "Manola," built by Pickands, Mather & Co. in 1890, has precisely the same engine power as the steamer "E. H. Gary," one of the giant ships built for the Steel Corporation. The "Manola" could carry 3,000 tons per trip. The "Gary" on the same fuel consumption carries over 10,000 tons. In fact, her largest cargo to date is 10,887 tons. The vessel owner after long experience has realized that the economical vessel is the steamer of large capacity and low power. That is why the steamers are gradually growing larger as the channels are being deepened for them, and why the consort system has been entirely abolished. There is not a barge now building on the Great Lakes, and there probably never will be again, though even 10 years ago the steamer and its consort was the prevailing mode of ore transportation on the Lakes.

Steamer Ball Brothers, 500 ft. Long, American Ship Building Company.

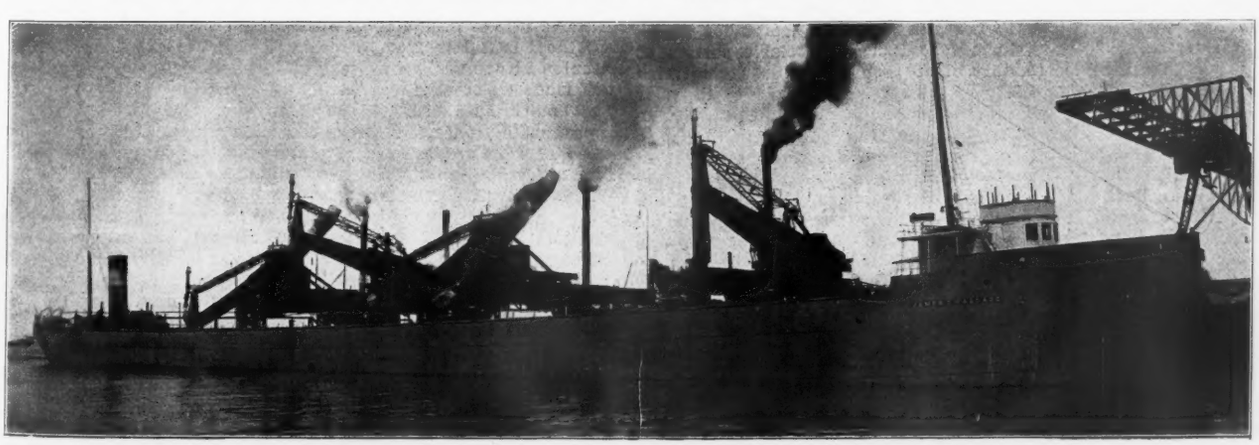
During the past two years, shipbuilders have exhibited great boldness in the design of the ore carrier. It is now a changed ship. Until three years ago all hatches were spaced 24 ft. centers. That is, it was 24 ft. from the center of one hatch to the center of the other. All hatches are now being spaced 12 ft. center, that is to say, it is 12 ft. from the center of one hatch to the center of the other. This leaves a deck strip of only 18 in. between hatches, and the deck is therefore almost a continuously open hole from pilot house to engine. The engines of the Lake freighters are, of course, crowded as far aft as it is possible to get them. By this system vessel hatches have been practically doubled in number, thus affording greater convenience in loading and greater despatch in unloading.

Three years ago, longitudinal rigidity was secured by stringers and stanchions extending from the sides of the vessel. These projections interfered with the unloading machines and it became necessary to obviate them in some manner if the utmost despatch was to be secured in unloading. Their place is now taken by a girder, straight in some ships and curved in others, extending from side to side of the ship directly between the hatches. This system leaves the hold absolutely unobstructed and is the accepted design of the lake freighter to-day. The system has marvelously facilitated the great unloading machines, the steamer "Geo. W. Perkins," with a cargo of 10,514 tons, having been unloaded only last week in four hours and ten minutes. The great unloading machines with automatic clam shell buckets grab from 10 to 12 tons of ore at a time and make a trip a minute. This cargo was actually unloaded directly into the cars, the car moving very slowly under the machines and receiving the contents of the buckets as it went along. Four of these buckets will fill a car. The "Perkins" took on this great cargo in 89 minutes, 9,000 tons of it being the work of the first 35 minutes. She was in port altogether 180 minutes, which included shifting. Ships of special design, docks of special design and unloading machines of special design all working in unison have brought this incredible despatch about. It is not to be found elsewhere in the world.

The following are this year's orders for new ships:

New Vessels for Ore Carrying Fleet.

Yard.	Name.	Carrying capacity gross tons.	For whom building.
Lorain ...	"Ball Bros.".....	8,000	G. A. Tomlinson, Duluth.
Lorain ...	"J. C. Wallace"....	10,000	Acme Steamship Co., Duluth.
Lorain ...	"S. M. Clement."...	8,000	Capt. John Mitchell, Cleveland.
Lorain ...	"Philip Minch."...	8,000	Henry Steinbruner, Cleveland.
Wyandotte	"Amasa Stone"....	10,000	Pickands, Mather & Co., Cleveland.
Wyandotte	"L. C. Smith".....	10,000	U. S. Trans. Co., Syracuse.
Cleveland.	"F. L. Robins."...	6,000	W. H. Becker, Cleveland.
W.Bay City	"Sylvania".....	9,000	G. A. Tomlinson, Duluth.
W.Bay City	"Socopa".....	9,000	G. A. Tomlinson, Duluth.
Lorain ...	"W. A. Rogers."...	10,000	Niagara Trans. Co., Tonawanda.
Cleveland.	"L. C. Hanna"....	9,000	Mahoning S. S. Co., Cleveland.
Wyandotte	"P. Stackhouse"...	9,000	Mahoning S. S. Co., Cleveland.
Cleveland.	"W. A. Paine".....	8,000	C. L. Hutchinson, Cleveland.
Chicago ..	"E. H. Gary".....	10,000	Pittsburg S. S. Co., Cleveland.
Chicago ..	"W. E. Corey".....	10,000	Pittsburg S. S. Co., Cleveland.
W.Superior	"G. W. Perkins."...	10,000	Pittsburg S. S. Co., Cleveland.
W.Bay City	"H. C. Frick".....	10,000	Pittsburg S. S. Co., Cleveland.
Ecorse....	"J. E. Davidson."...	9,000	G. A. Tomlinson, Duluth.
Ecorse....	"Hoover & Mason."	9,000	G. A. Tomlinson, Duluth.
Ecorse....	"W. G. Mather"...	10,000	Cleveland Cliffs Iron Co.
Ecorse....	"Peter White"...	9,000	Presque Isle Trans. Co., Cleveland
St. Clair..	"G. H. Russel."...	7,500	Gilchrist Trans. Co., Cleveland.
St. Clair..	"F. J. Hecker"...	7,500	Gilchrist Trans. Co., Cleveland.
Toledo ...	"James P. Walsh".	8,000	C. O. Jenkins, Cleveland.
Lorain ...	Unnamed.....	9,000	C. L. Hutchinson, Cleveland.
Cleveland.	Unnamed.....	6,500	Capt. John Mitchell, Cleveland.
Cleveland.	Unnamed.....	10,000	H. A. Hawgod, Cleveland.
Cleveland.	Unnamed.....	9,000	Wilson Trans. Co., Cleveland.
Lorain ...	Unnamed.....	10,000	Capt. C. L. Hutchinson, Cleveland.
Lorain ...	Unnamed.....	10,000	Capt. John Mitchell, Cleveland.
Bay City..	Unnamed.....	9,500	Gilchrist Trans. Co., Cleveland.
Bay City..	Unnamed.....	9,500	Gilchrist Trans. Co., Cleveland.
Wyandotte	Unnamed.....	8,000	Hugh McMillan, Detroit.
Wyandotte	Unnamed.....	9,000	E. D. Carter, Erie.
Cleveland.	Unnamed.....	8,000	W. C. Richardson, Cleveland.
Ecorse....	Unnamed.....	10,000	Jones & Laughlin, Pittsburg.
Ecorse....	Unnamed.....	10,000	Jones & Laughlin, Pittsburg.
Ecorse	Unnamed.....	10,000	Globe Steamship Co., Duluth.
Toledo ...	Unnamed.....	8,000	L. S. Sullivan, Toledo.
	Total, in one trip	370,500	
	Total, season of 20 trips..	7,220,000	



Hulett Clam Shell Machines Unloading the James C. Wallace (552 ft. Long.)

Picked up on the Road.

BY GULF.

It is always interesting to the outsider to note how some big roads "don't do it." At a station of a fairly large city on a big and progressive line, if we take the general passenger agent's word for it, the ticket office is not opened for a fast train making a regular stop at that point. Why? Because it is composed entirely of parlor cars, and tickets cannot be sold, as they do not know whether there are any vacant seats or not. Oh, yes, there is plenty of time to hear; an hour and a half, after leaving the last station above, and the train slows down through an important junction station. Seats? Well, the car I entered had four of its 24 occupied. But you see the G. P. A. was too busy advertising the superiority of his road and the magnificence of its service to look after such minor matters as the comfort and convenience of its passengers.

Superheated steam is a profitable thing in a locomotive and the statement applies as well to compound as to simple engines. In the case of the former, however, there is still some doubt as to just how the superheating should be done. That is to say, whether the whole energy should be devoted to the steam before it is admitted to the high-pressure cylinder, or whether there should be a reheating and added superheating between the two cylinders. The point is one that will probably require some time and more expense to settle and is under investigation at the present time in Europe. When our friends over there have demonstrated to their own satisfaction which is the better plan we may hope to see some attention paid to the subject here. Meanwhile, to quote an oft repeated phrase used by the progressive American railroad man: "We will let the other fellow do the experimenting."

We hear much at all times and in all places regarding the variables that enter into all matters of railroad operation, and of the impossibility of applying any specific formula to any wide range of operations whatever they may be. It would seem that this should hold true regarding the guarantees that are asked and offered on cast-iron wheels. To be sure, when these wheels are under freight equipment, they may travel from one end of the country to the other, though under the per diem system of accounting, cars are more apt to make the majority of their mileage on the home road. If this is the fact it would seem reasonable that roads having a clean level track should get a greater mileage out of their wheels than those among the mountains or on sandy plains. In both these latter cases the wear is perceptibly faster and the service more severe with a corresponding decrease in the life of the wheel. But to the outside layman it seems as though it would be a rather difficult job to so adjust the guarantee as to be fair to all interested parties.

The truth of the old saying that "trifles make perfection and perfection is no trifle," seems to be lost to sight in the operating circles of most railroads in view of the weightier matters of the law. Apropos! It was a hot July day and the car was baking hot with nearly every window open. A brakeman came down through the car just before a 3,000 ft. tunnel was reached. Why did he not warn the passengers and tell them to close the windows? He had not been so instructed and of course it would never enter his head to do it of his own accord. So the car was filled with gas and smoke for the remaining 50 miles of the run, all because a small matter had been neglected by the man higher up.

The superintendent of motive power of a big trunk line, in speaking of high capacity cars and the efficiency of the cast-iron wheel, told me recently that one of the greatest causes of anxiety to the operating officers of his road was the high percentage of chances of trouble due to a freight train causing a passenger wreck. Where the traffic is heavy and freight trains long, passenger trains are passing them for a very appreciable portion of the time. If, then, the liability of an accident to passenger trains is increased by this in the open, what shall be said of tunnels? It would seem to be quite in accord with the principles of the absolute block to debar a freight train from entering a tunnel in one direction while a passenger train was moving through it in the opposite. But as the absolute block has not yet reached the point of practical adoption in this easy going land of ours, we will probably have to bide a wee before freight trains will be excluded from tunnels in which there is a passenger train. I sometimes wonder if we shall have to wait for a half million dollar accident to teach the lesson, after which there will be a legislative awakening.

While it is quite true that railroad rolling stock is not built to be wrecked or make a fine appearance on the scrap heap, it is equally true that the scrap heap and the remnants of a wreck are sometimes the most valuable object lessons as to what should be imitated or avoided in car or locomotive construction. Consider, for example, the value of strong platform construction in a bad wreck. In a certain case an engine ran into an open switch at a speed of about 70 miles an hour, went down a bank, rolled over on its side and slid over the ground in that position for about twice its length. It rested on its wide firebox and cylinders and did not even bend its rods, while the tank was absolutely uninjured. A postal car went down the bank and rolled over and had all the paneling stripped off from one side. The other cars had the corners damaged, one being entirely torn away. The platform on this injured car was not damaged in the slightest and was as straight and true after the accident as when turned out of the shop. This statement holds true of the platforms on all of the other cars of the train. The platform must have been of an exceedingly strong construction to have withstood this strain and probably paid for itself many hundreds of times in the immunity from dangers which it provided in the case of this accident alone. The corners of other cars were not carried away, which is attributed to the fact that the ends were strengthened by a heavy plate extending from side sill to side sill, up the sides and across the roof. Such structures seem to be good insurance policies, that make their returns, if any, in a satisfactory, if uncalculable, manner.

Some surprise, much disgust and a great deal of unreasoning censure has been developed by the condition of the air in the New York subway. People have jumped to the conclusion that because there was an odor and the temperature was high that things down there were about as bad as they could be. As for odors, we have, first, the rubbing of the contact shoes on the third rail, quite enough to produce what nostrils trained to such things will readily recognize as the odor of friction. Not altogether agreeable, but not injurious. Then comes the odor of oil. Of course it is warm down there. Suppose the steam generated in the power plant were to be led in pipes along the subway, and from 8 to 10 per cent. of it were to be discharged into that hole in the ground with an even distribution throughout the entire length. You would expect a rise of temperature would you not? Well, if there is any truth in the theory of the conservation of energy, then every particle of heat that is taken up by the engines in the power house and transformed into energy and motion is bound to reappear again as heat in the subway; and that would seem sufficient in quantity to raise the underground temperature many degrees.

Graphic Train Logs.

BY PAUL T. WARNER.

A train log in the form of a speed curve, which shows at a glance all stops and variations in speed on the run, is an interesting record, easily prepared with the help of an ordinary watch. A note is made of the time—in hours, minutes and seconds—of passing each mile post; also of the arriving and departing times at stations, and at any intermediate stops which may occur. In this way the elapsed time between mile posts is usually correct within one second, and the total time between terminals is absolutely correct. Check readings made when passing the principal intermediate stations should also be secured where possible. A time card giving the mileage is of great assistance in plotting the curve, and a profile of the division—if one can be secured—adds much valuable information. Data regarding the engine and train, as well as other interesting points connected with the run, can frequently be obtained.

The four curves here reproduced were prepared by the writer in the manner indicated. Fig. 1 shows a run on the Atlantic City division of the Pennsylvania Railroad. Train No. 629 runs via the Delaware River Bridge, and satisfactory readings between mile posts could not be secured until after reaching the main track of the West Jersey and Seashore, some distance out of Camden. For convenience in plotting, the distances are laid off from the Atlantic City end. This train is scheduled to run the 69.4 miles from Broad St. Station to Atlantic City in 80 minutes, at an average speed of 52 miles per hour, and in the present instance was on time, covering the 30.6 miles from Winslow Junction to Drawbridge in 26 minutes 28 seconds, an average of 69.3 miles per hour. The train was made up of nine cars, estimated to weigh about 310 tons, and was hauled by Class E-2 locomotive No. 1986 (4-4-2 type). An approximate profile of the road is reproduced, and the effect, on the speed, of short grades is, in several instances, plainly to be observed. This is especially noticeable near mile posts 48, 40, 19 and 11. Near Winslow Junction the train was slowed to scoop water. The almost level stretch after passing Egg Harbor was covered at an average of about 72 miles per hour, which, according to the usually accepted formulas for train resistance, represents at least 1,700 horse power. This run, it should be noted, is by no means exceptional for the Atlantic City division, as the 60-minute trains via Camden maintain considerably higher speed than that recorded here. (*Railroad Gazette*, June 24, 1904.)

Fig. 2 shows a run on the New York Division of the Pennsylvania, the average speed, deducting stops, being 52.1 miles per hour. Train No. 102 runs from Broad St. station to Jersey City, 89.4 miles, in 107 minutes, equivalent to 49.9 miles per hour. The engine, in this instance, was No. 612, Class E-2-A (4-4-2 type with Belpaire boiler), and the load was light, consisting of two Pull-

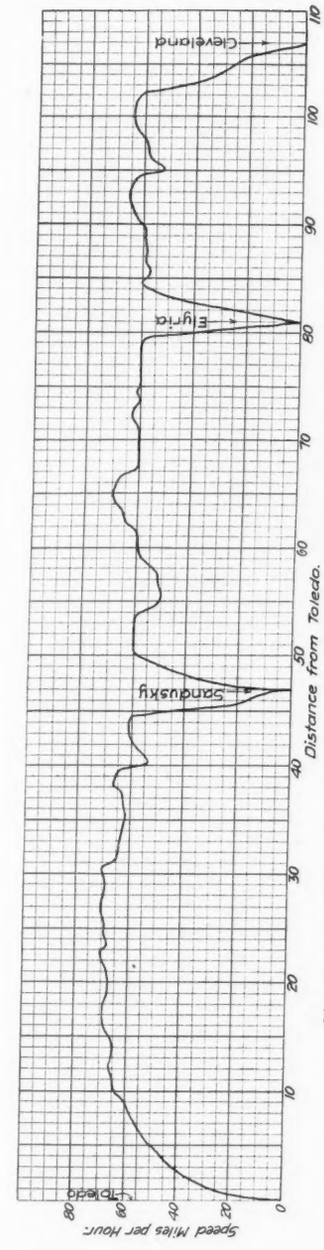


Fig. 4—Log of Run from Toledo to Cleveland—Lake Shore & Michigan Southern.

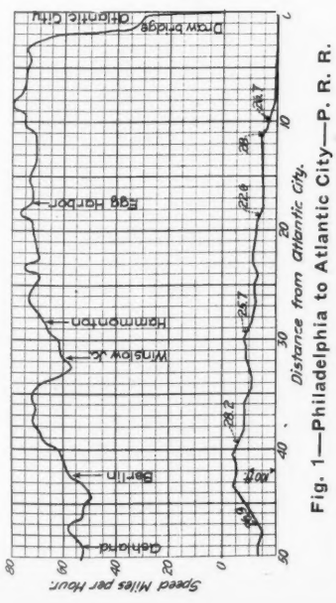


Fig. 1—Philadelphia to Atlantic City—P. R. R.

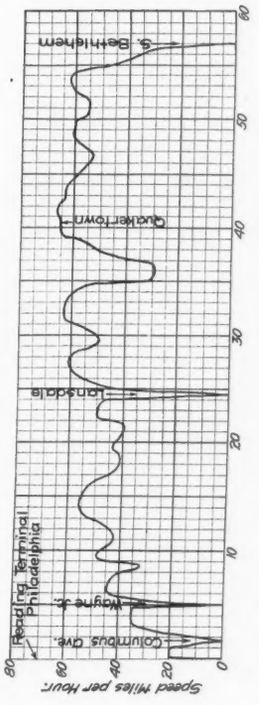


Fig. 3—Log of Run from Philadelphia to South Bethlehem—P. & R.

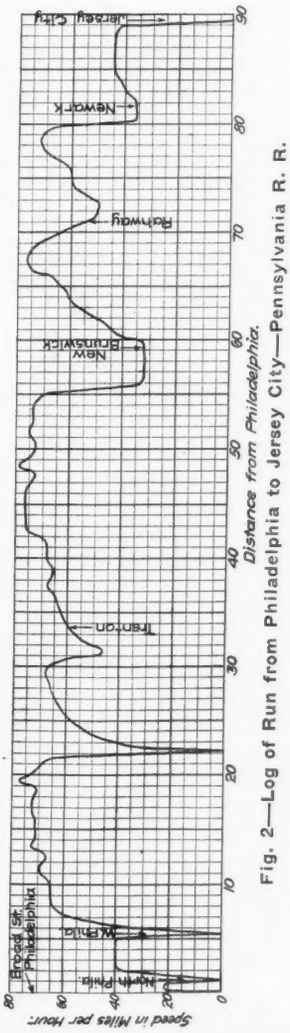


Fig. 2—Log of Run from Philadelphia to Jersey City—Pennsylvania R. R.

mans and three coaches. Station stops were made at West Philadelphia and North Philadelphia, and there was a short dead stop for a signal after passing mile post 22. The speed reduction at mile post 31 was made for the curve near Morrisville, which, since the opening of the new stone bridge across the Delaware, has been abandoned. Track elevation and change of line at New Brunswick and Newark necessitated slow running through both cities, and there was also a reduction in speed while passing through Rahway. Jersey City was reached about one minute ahead of time, after crossing the "meadows" at a moderate speed. This curve is strongly suggestive of higher speed in the future, when the various improvements, both under way and contemplated, will have been completed.

Fig. 3 shows a run on the Bethlehem Branch of the Philadelphia & Reading. This 57-mile stretch of double track, besides handling a fair amount of local and freight traffic, carries all the Philadelphia connections of both the Central Railroad of New Jersey and the Lehigh Valley Railroad. Train 319 runs through to Scranton *via* the Central Railroad of New Jersey, and is scheduled to reach South Bethlehem in 88 minutes, averaging 38.8 miles per hour. The road is crooked and hilly, and there are three station stops for this train. The load was light, consisting of one combination car, one coach and one Pullman (all vestibuled), and was hauled by Central Railroad of New Jersey engine No. 604, a 4-6-0 type with 19 in. x 26 in. cylinders and 69 in. drivers. The average speed, deducting time for stops, was 43.5 miles per hour. Speed was reduced near mile post 9 on account of track repairs, and also at mile post 35 to pass through Perkasie tunnel; all other variations are directly due to grades and curves. The fastest mile was timed in 54 seconds, shortly after passing Quakertown. The curve probably shows about the best performance possible on a line having as many grades and curves as this one.

Fig. 4 is the record of a run, over the Toledo division of the Lake Shore and Michigan Southern, which was made by mail train No. 32. This train leaves Chicago at 3.00 A. M., and between Elkhart and Toledo runs *via* the "old road" through Southern Michigan, which is single tracked. On this occasion No. 32 was detained between Hillsdale and Adrian by an opposing freight, which had become stalled on a grade and so failed to make a meeting point in time. Class I, engine No. 601 (4-6-0 type), which was hauling the train, left Adrian 33 minutes late and made up 10 minutes to Toledo, where engines 668 and 661 (Class J, 2-6-2 type) were coupled on. The load consisted of six mail and express cars, two coaches and one Pullman. Cleveland was reached two minutes ahead of time, the average speed, deducting stops, being 52.2 miles per hour. This is a very favorable stretch for fast running, and with so much power at the head of the train the locomotive work was easy. There is one long grade of 15.84 ft. per mile west of Elyria, but it had no noticeable effect on the speed, which was very well sustained—especially between Toledo and Sandusky. The engines making this run were among the earlier of the 2-6-2 type used on the Lake Shore, the new class K engines having just gone into service.

These runs were all made under ordinary conditions, and are representative of the every day work that is being done on American railroads.

Accident Bulletin No. 15.*

The Interstate Commerce Commission has issued Accident Bulletin No. 15, summarizing the records of the railroad accidents in the United States during the three months ending March 31, 1905. The number of persons killed in train accidents was 232, and of injured 3,713. Accidents of other kinds, including those sustained by employees while at work, and by passengers in getting on or off the cars, etc., bring the total number of casualties up to 909 killed and 14,397 injured. These reports deal only with (*a*) passengers and (*b*) employees on duty.

Table No. 1.—Summary of Casualties to Persons.

	Passengers—		—Employees—	
	Killed.	Injured.	Killed.	Injured.
Collisions	18	834	104	1,104
Derailments	9	794	70	516
Miscellaneous train accidents	1	23	30	442
Total train accidents	28	1,651	204	2,062
Coupling and uncoupling	..	.....	62	790
While doing other work about trains	..	.....	65	3,475
Overhead bridges, etc	..	3	21	303
Getting on or falling from cars or eng.	24	317	155	2,540
Other causes	12	343	338	2,913
Total	36	663	641	10,021
Total, all classes	64	2,314	845	12,083

The totals in this table are not strikingly different from those in Bulletin No. 11, covering the same quarter of the preceding year, though there is a decrease of 12 in the number of passengers killed in train accidents. In this item Bulletin No. 11 was swelled by one

*The *Railroad Gazette* report of the train accidents which occurred in the month of January was published in our issue of Feb. 24, p. 155; that for February on March 24, p. 275; and that for March on April 21, p. 363.

collision which killed 18 persons. In the present record the largest passenger death list was that of collision No. 24, in which 7 were killed. Particulars of this and other collisions are given below. Coupling accidents, while fewer than one year ago, do not show any marked falling off in fatalities. From the details of "coupling accidents," as given in Table 3, it is evident that a considerable percentage of the injuries classed under this head are of a kind not peculiar to this department of work, but are due to causes which occur, and probably to about the same extent, in other kinds of work.

The total number of collisions and derailments was 3,108 as shown below:

Table No. 2.—Collisions and Derailments.

	No.	Loss.	Persons Killed.	Persons Injured.
Collisions: Rear	511	$473,785	44	634
Butting	203	350,704	47	650
Trains separating	252	90,754	2	109
Miscellaneous	821	343,834	29	545
Total collisions	1,787	$1,259,077	122	1,938
Derailments due to:				
Defects of roadway, etc.	334	$328,326	19	506
Defects of equipment	598	439,354	7	234
Negligence of trainmen, signalmen, etc	72	43,744	7	70
Unforeseen obstruction of track, etc.	92	113,968	19	165
Malicious obstruction of track, etc.	11	20,240	3	46
Miscellaneous causes	214	244,539	24	289
Total derailments	1,321	$1,190,171	79	1,310
Total, collisions and derailments	3,108	$2,449,248	201	3,248

Derailments at derailing switches caused losses of $18,652 in this quarter, and of $29,735 in the quarter last preceding (not including personal injuries and losses of merchandise). In the present quarter two of these derailments are charged to the fault of the tower man; one to a runaway, due to bad management of the air brakes by the engineman; one to the freezing of a distant signal in the clear position, and one to a defect in the derailing switch. Other cases are reported as due to the more ordinary kinds of carelessness. In one instance the engineman had been on duty twenty hours. In the list for the preceding quarter two derailing switch accidents were reported as due to the engineman falling asleep. In another the engineman mistook the signal light; the light which should have guided him had been accidentally extinguished, but he saw some other light, which he took to be the signal light. One case was due to bad hand signaling, and in one case a signalman changed the position of a derailing switch when the train was too near to it. This signalman was 18 years old.

Following is the usual list of Class A train accidents—all in which the damage is reported at $10,000 or over; notable cases in which passengers are killed, and those doing damage less than $10,000 and down to $2,000, wherever the circumstances or the cause may be of particular interest:

Causes of Forty Prominent Train Accidents (Class A).

[Note.—R. stands for rear collision; B., butting collision; M., miscellaneous collisions; D., derailment; P., passenger train; F., freight and miscellaneous trains.]

No.	Class.		Killed.	Injured.	Damage to engines, cars, & roadway.	Reference to record.	Cause.
					COLLISIONS.		
1	R.	F. & F.	4	2	$700	7	Empty engine ran into rear of standing freight, killing 4 passengers in caboose; caboose took fire and, with occupants, was burned up. The standing train was not properly protected, and the approaching engine was running at excessive speed.
2	R.	F. & F.	3	1	700	54	Freight, standing at water-tank, run into by following freight approaching at unauthorized speed; 3 passengers in caboose killed.
3	B.	P. & P.	1	8	2,300	29	Despatcher's meeting order incorrectly copied by one of three operators though repeated to despatcher correctly. Stop signal was displayed at meeting point, but engineman holding the incorrect order ran past this signal 400 ft.; dense fog.
4	B.	P. & F.	2	3	3,064	61	Both enginemen and both firemen of "double-head" freight forgot about passenger train; these men on duty 19 hours.
5	B.	P. & F.	0	7	3,133	31	Operator (4 months in this place and 4 months' experience in telegraph work elsewhere) delivered clearance card instead of meeting order. This operator (at the meeting point) was to have delivered clearance to the other train if it had arrived first. In sending a meeting order to the meeting point the despatcher should direct the operator to take special precautions, but failed to do so.
6	B.	P. & F.	0	6	4,700	10	Two engines coupled together, going to assistance of passenger train stalled in snow, collided with passenger train. Passenger brakeman had placed torpedo signals, but these were not heard. He is censured for not using fusees also. The engines, however, had been notified by one flagman some distance back.
7	B.	F. & F.	2	2	4,800	62	Operator (in service 3 weeks, experience elsewhere, 1 year) wrote name of wrong station in meeting order.
8	R.	F. & F.	0	1	5,000	6	Engineman (50 years old), intoxicated, ran at excessive speed and did not heed flag.
9	B.	F. & F.	0	2	5,000	36	Operator neglected to deliver order. Both engines had electric headlights, and 1 engineman admitted that he had seen the light of the other train several miles away, but thought that it was on a sidetrack.
10	M.	F.	0	0	5,100	39	Part of train left standing on grade without hand-brakes set.
11	B.	P. & F.	0	7	5,118	32	Passenger train, stuck in snow, did not send flag ahead. Freight engineman ran unreasonably fast, having been informed about passenger train.
12	B.	F. & F.	0	1	5,800	34	Block-signal operator, 16 years' experience, turned eastbound freight into siding against westbound empty engine (standing), having forgotten about presence of empty engine.
13	R.	F. & F.	0	2	6,656	27	Engineman approached yard at unauthorized speed; on duty 22 hrs. 35 mins.; 9 locomotives damaged.
14	M.	P. & F.	1	1	6,800	66	Freight encroached on time of passenger train; men at fault on duty 18 hrs.
15	B.	P. & F.	0	19	7,300	33	Block-signal operator gave yard engine time against passenger train after despatcher had refused to do so; passenger train approached at unauthorized speed.
16	B.	F. & F.	0	6	7,600	35	Conductor and engineman disregarded meeting order; reported by railroad company as "criminally responsible." (See note in text below.)
17	B.	F. & F.	1	4	7,800	12	Conductor, engineman and brakeman failed to identify train on sidetrack. (See note in text below.)
18	B.	P. & F.	2	23	10,800	57	Engineman of eastbound freight encroached on time of westbound passenger, having "gained the impression" that he had 3 hours 30 minutes against it when he had only 30 minutes. Conductor did not act promptly to stop train.
19	R.	P. & F.	2	6	13,175	1	Passenger train, without headlight, collided with engine standing in yard without red lights displayed.
20	R.	P. & F.	1	5	13,900	2	Freight encroached on time of passenger train in consequence of failure of two watches. (See note in text below.)
21	B.	P. & F.	3	12	14,200	8	Freight encroached on time of passenger train in dense fog; conductor relied on another conductor to flag him to the meeting point, but the other conductor claims he had not accepted that responsibility.
22	B.	F. & F.	4	6	15,731	21	"Double-head" freight train ran past meeting point. (See note in the text below.)
23	B.	F. & F.	2	3	19,635	63	Engineman fell asleep and ran past meeting point. (See note in text below.)
24	R.	P. & P.	7	142	44,000	51	7 passengers killed, some of them suffering from fire: engineman, running at high-speed at night, ran past distant signal without observing its position, and then ran 900 ft. past home signal, striking preceding train, which had been stopped because of a hot journal.
Total			35	269	$213,012		
					DERAILMENTS.		
1	D.	F.	5	1	$800	49	Excessive speed; work-train running with tender first.
2	D.	P.	0	2	2,775	17	Derailing switch open; distant signal (9 p. m.) frozen in clear position; signalman negligent.
3	D.	F.	1	2	3,900	68	Track distorted by solar heat (Mar. 29.)
4	D.	P.	1	1	9,148	73	Landslide; watchman had passed over track just before; damage partly due to fire; gas tank exploded.
5	D.	F.	0	0	10,000	42	Flange of wheel of tender broken.
6	D.	P.	0	8	11,000	78	Unexplained; speed 35 miles an hour; tender derailed on good track.
7	D.	P.	1	13	12,400	76	Rails maliciously loosened.
8	D.	P.	0	1	14,725	74	Burning bridge (3 p. m.).
9	D.	P.	0	30	15,741	18	Rock fell on track (night).
10	D.	P.	0	19	18,700	15	Broken 80-lb. rail; 12 years old; internal flaw.
11	D.	F.	1	0	19,800	24	Runaway (4 trespassers killed). (See note in text below.)
12	D.	F.	0	0	20,000	16	Broken wheel; wheel excessively heated by brakes; defective casting.
13	D.	P.	0	56	22,500	48	Baggage car of rapidly moving train blown off track by explosion of boiler of engine of another train passing in opposite direction on adjacent track.
14	D.	P.	1	20	25,360	77	Excessive speed on curve. Engineman was making his first trip over this division; had made 20 round trips to learn the road.
15	D.	F	3	1	25,500	20	Runaway; men in charge of train had neglected to test brakes at head of grade; depended partly on hand-brakes, but did not apply them soon enough. The first brakeman on the train had had 9 months' experience; the second, 6 months, and the third, none.

No.	Class.		Killed.	Injured.	Damage to engines, cars, & roadway.	Reference to record.	Cause.
DERAILMENTS.—(*Continued.*)							
16	D.	P.	1	40	65,000	41	Broken rail at entrance to bridge; 8 cars and bridge destroyed. Rail, 85-lb. 3 years old, was split longitudinally for 5 ft.; internal defect. Train running about 50 miles an hour, drawn by two heavy Atlantic-type engines.
Total.....			14	194	$277,349		
Grand total.			49	463	$490,361		

The most notable accident in this list, collision No. 24, occurred on a road thoroughly equipped with automatic block signals, the cause being bald inattention to signals on the part of an engineman whose record had been good. For about 12 miles this engineman, running at high speed, closely following the other passenger train, had encountered successive signals about three-fourths of a mile apart, all indicating "all right." As he approached the distant signal which was against him, that signal was obscured by the smoke from a locomotive on another track, and he passed the signal without knowing its indication. He gives no satisfactory explanation of this, from which the conclusion is drawn that he had assumed that the signal indicated "all right," with no other ground for such assumption than that he had found the preceding signals "all right." But he knew that he had passed a distant signal, and thus was bound to prepare to stop at the home signal. Not only did this man ignore the distant signal, but evidently after passing it he allowed his attention to be drawn away, for he did not observe the home signal until he was quite near to it. The distant signal which was obscured by smoke ought to have been seen by the engineman 1,070 ft. before reaching it.

The fireman of this engine, who ordinarily watches for signals when practicable, had seen all the signals for several miles, but at this particular point he was engaged in putting coal into the firebox and did not give his attention to the signal. The fire in this wreck broke out in less than one minute after the collision. It was rapidly spread by gas escaping from broken pipes beneath the cars, and was started, no doubt, by the ignition of this gas by the fire in the wrecked locomotive or the flames of the lamps or by friction. The three rear cars of the foremost train and the three leading cars of the second train were burned up.

In collisions No. 1 and No. 2, taken together, seven passengers were killed while riding in caboose cars attached to the rear of freight trains. In connection with these cases it may be observed that it has long been generally recognized that the lives of passengers are not so safe on freight trains as on passenger trains.

In three of the accidents in this list the men at fault had been on duty for an excessive length of time; in one case, 19 hours; in another, 22 hours 35 minutes, and in a third, 18 hours.

Collision No. 8, due to the reckless conduct of an engineman who was intoxicated, is the first case of this kind which has come to notice since the accident records have been kept.

In collision No. 16, a butting collision between two heavy freight trains, eastbound train No. 8 received orders to meet westbound No. 5 at A and No. 7 at B. On arrival at A, No. 5 was met, and the eastbound (No. 8) immediately received a second order to meet No. 7 at A instead of B, and to meet second No. 7 at B. The conductor and engineman read and signed this order, and then immediately went to their train and started out, utterly disregarding the order. The conductor and engineman claim to have been under the impression that they were to meet only one train at A, but this one train was met before they received the second order. The fireman of No. 8 was disciplined for failing to read the order when it was handed to him by the engineman. This fireman's experience was one year. The conductor and engineman had each had several years' experience.

Collision No. 17 was due to the failure of the men on train No. 1, westbound, to identify an eastbound train standing on a side track. The fireman of the westbound, holding a lantern in his hand, stood in the gangway of the engine as, moving at about five miles an hour, it passed the engine standing on the side track. On account of escaping steam he was unable to see the number distinctly, but was satisfied that it was not the number which he was looking for (that of the engine of train No. 2). Failing to get the desired information, but wishing to save time by avoiding a stop, the engineman of No. 1, on passing the caboose of the standing train, asked the flagman, who was in the cupola, if his train was No. 2, and the flagman is claimed to have replied "yes." The flagman, however, says that he did not understand the question, did not answer "yes," and merely tried to get the engineman to repeat his question.

Collision No. 20 was due to a miscalculation of time, and both the engineman's and the conductor's watches were out of order. The conductor's was 19 minutes slow, and the engineman's had stopped at 10.56 a.m. by the minute hand being blocked by the hour hand. The engineman was fatally injured. The conductor's watch had on the previous day been thrown violently to the ground by an accident. When picked up it was running, in apparently good condition, but the conductor had not afterwards compared it with any other timepiece. Furthermore, the conductor and engineman had neglected to compare the time by their watches when they received the meeting order.

In collision No. 22 the train which overran the meeting point—the eastbound—was drawn by two engines, and the enginemen of both these engines disobeyed the meeting order. The engineman and fireman of the second engine were killed. All four men on the engines had also disregarded the rule forbidding a train to pass a passing track without receiving an "all right" signal from the conductor. The surviving engineman had "got the impression" in his mind that the meeting order specified another station five miles beyond. There was no reason or excuse for this impression, and he gives no explanation of it. His conversation with the operator at the time he received the order was such as to prove that he had read it correctly. He was unable to state positively that he had read the order to his fireman. The fireman admits that he did not read the order, though both claim that their habits in this matter had been correct. Both trains held orders to meet at W. As the eastbound was approaching W. the station signal was sounded by one of the enginemen, and the stop signal was given by the flagman, under direction of the conductor. The signal was answered from the engine, but the train did not reduce speed; and the conductor, seeing that they were going to pass the station, had the flagman get out on top of the train and endeavor to give an effective stop signal to the enginemen. He failed to get them to notice his signal, and his lamp went out. On account of the speed of the train and the possibility of meeting the opposing train at any moment, the flagman and conductor were afraid to attempt to go over the seven non-air cars in order to open the angle cock and apply the air-brake. The conductor is held at fault for failing to have his three brakemen in the proper positions on the train to pass along the hand signals when approaching a meeting point. These brakemen were also at fault for not being in proper positions on the train.

Collision No. 23 occurred about 5 a.m., and was caused by one of the freight trains running past a side track, where it should have waited for the train from the opposite direction. The engineman of this train had fallen asleep and a brakeman on the engine with him (who was killed) probably also had fallen asleep. The fireman of the train was not sufficiently familiar with the road to know that he was running past a station, there being no station lights at the point in question. The engineman had been awake about three minutes before the collision. The report of the railroad company says that he had voluntarily overworked himself, failing to ask for rest, and concealing the actual facts from his superior officers. After a run of 14 hours, preceded by a short rest, he lay off for 2 hours 55 minutes, and then entered upon the run of 10 hours which terminated in the collision. At the end of his 14-hour run he told the roundhouse foreman that if needed to go back he would be ready to go whenever called.

The fireman had been on the road only three months, including the time spent in learning. He also had worked the excessive hours above mentioned. The brakeman who was killed on the engine had had eight months' experience. The conductor tried to signal the engineman to stop, but, as before stated, the brakeman on the engine, who should have seen this signal, was probably asleep. The conductor and one of his brakemen, the latter of eight months' experience, neglected to make proper effort to apply the air-brake valve on one of the freight cars in the train.

Derailment No. 11 was a runaway of a train over 10 miles of a crooked road. It was due to the negligence of trainmen in leaving the cars of the train standing on a grade without having enough hand brakes applied to keep them from moving. The train was stopped in a tunnel by the bursting of an air-brake hose. While making repairs a new trainman was overcome by gas and smoke, and the engine had to be detached from the cars to carry this brakeman out of the tunnel to save his life. While the engine was detached the air leaked out from the brake cylinders of the cars in the train and this caused the runaway. When the cars struck the engine (which had started to return) the engineman was knocked off and the fireman jumped off. The conductor of the train did not board it when it started, for the reason that he also had been overcome by gas. On eight or nine cars the hand brakes had been set before entering the tunnel, but these were not enough to hold the train. After running 10 miles, on a 1 per cent. grade, the train was derailed on a curve of 10 deg. where the outer rail was elevated 7 in. The engine and 34 cars were destroyed. The fireman who jumped off had been in the employ of the company two months.

Table No. 3, given below, showing details of accidents to employees in coupling and uncoupling cars, has been put into a new

form so as to show more clearly the circumstances under which the injuries occurred.

The subclassification in this table is designed to separate, as far as practicable, those accidents which are due to the employee's own carelessness, defective judgment, or disobedience of rules from those which are due to faults in the couplers or to non-compliance with the law by the railroad company. In a large part of the cases it is impossible to classify perfectly, as two or more causes contribute to the accident. For example, some cases fall into subclass 24 without question; in others the circumstances are such that doubt arises. In sub-class 14 some cases are clearly due to recklessness; in other cases the man was one of reasonably cautious habits, and his error is to be classed simply as misadventure. Cases in sub-class 11 are sometimes due to palpably blameworthy conduct on the part of the injured person, and sometimes to hurried work, which a jury would readily class as excusable, if not justifiable. Other considerations like those here mentioned will occur to the reader in connection with some other sub-classes.

Sub-class 27 includes cases which it has been difficult or impossible to classify. Some of these ought possibly to go into subclass 4 (cars not equipped with automatic couplers), and in other cases the man appears to have been only indirectly connected with coupling operations, and the accident should have been put into some other class; but it has been impossible as yet to fully clear up the facts of these cases by correspondence.

Table No. 3.—Details of Table 1—Causes of Accidents to Employees in Coupling and Uncoupling Cars.

Sub-class.	Causes.	Employees. Killed.	Injured.
1	Adjusting coupler with foot	..	38
2	Adjusting coupler, cars accidentally started	1	36
3	Careless manipulation of uncoupling lever	..	8
4	Cars not equipped with automatic coupler	..	11
5	Coupler broken, using link and pin, or chain	2	16
6	Coupling damaged cars	3	32
7	Coupling with chain or other emergency appliance on curve too sharp for automatic coupling	..	7
8	Coupling with chain or other emergency appliance because of uneven track	..	1
9	Coupling or uncoupling safety chains	..	16
10	Fingers or hand caught bet. uncoupling lever & body of car	1	148
11	Uncoupling without using lever (unnecessary)	..	29
12	Uncoupling without using lever, uncoupling lever not in working order	5	88
13	Foot caught in frog, switch or guard rail	7	14
14	Opening or closing knuckle when cars were near together, miscalculated speed	6	44
15	Opening knuckle when cars were near together, engine accidentally started	3	11
16	Opening knuckle, part of defective coupler fell on foot	..	18
17	Opening knuckle, lost footing	2	10
18	Riding on car to uncouple, slipped off	1	4
19	Struck by object at side of track	..	35
20	Caught by unexpected movement of car, due to slack running in	6	62
21	Caught by unexpected movement of car, due to mistake or misunderstanding in giving hand-signals	..	4
22	Uncoupling moving cars and lost footing	4	54
23	Parts hard to move, causing delay	..	40
24	Went between cars unnecessarily and contrary to rule	4	15
25	Hand caught between projecting load and end of next car	..	8
26	No witness (fatal injury)	16	..
27	Other causes	1	35
28	Unexplained	..	6
	Total	62	790

Table No. 3A.—Nature of Injuries to Employees in Coupling and Uncoupling Cars.

Injuries.	Trainmen.	Trainmen in yards.	Yard trainmen.	Other employees.
Loss of feet	1	1	2	..
" legs	4	1	..	..
" arms	3	3	1	..
" hands	1	3	1	..
" fingers	9	6	11	2
" toes	..	..	2	..
Fractured skull	..	..	..	..
" leg	..	..	2	1
" arm	2	3	3	..
" collar bone or ribs	4	5	7	1
" other bones	4	3	4	1
Contusion of head or body	16	20	59	4
" or laceration of feet	19	15	27	..
" " " " toes	2	4	9	..
" " " " legs	3	3	22	..
" " " " arms	10	7	14	..
" " " " hands	27	25	50	3
" " " " fingers	77	52	148	4
Dislocation	..	..	..	..
Internal injuries	3	6	21	1
Sprains	7	6	13	1
Shock	1	1	..	..
Miscellaneous	2	6	10	1
Total injuries	195	170	406	19
Killed	16	16	27	3
Total killed and injured	211	186	433	22

RECAPITULATION.

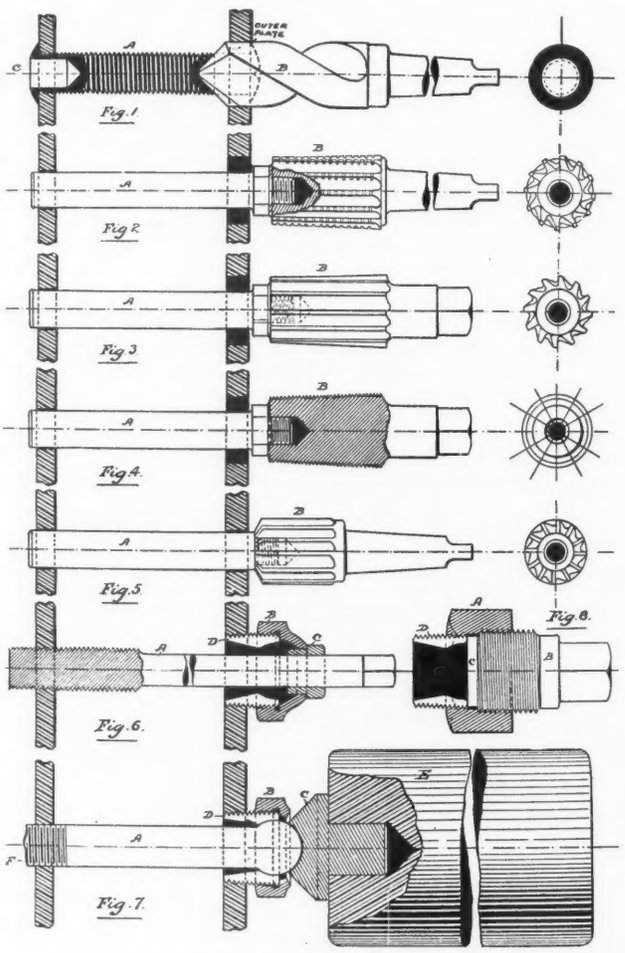
Killed	62
Injured	790
Total killed and injured	852

Firebox Staybolts.

At the April meeting of the Railway Club of Pittsburg, Mr. B. E. D. Stafford presented a paper on locomotive water space stays in which he discussed the advantage accruing from the use of flexible staybolts. The use of a rigid staybolt from which the threads had been cut away between the sheets was touched upon and it was held that it has been found that the reduction of the diameter in the water space has not been of any material benefit to the life of the staybolts. The flexible staybolt has the preference over the full threaded bolt to the extent that deposits, carbonates and sulphates of lime and magnesia, which precipitate from the waters used, do not adhere so closely and do not impair the quality of strength of the iron to such a marked extent as when threaded. Then, too, the instant staybolt irons are heated to the degree of firebox temperatures, all characteristics change, and all valuations based on a cold test are naturally questioned as serviceable values.

Staybolt breakages occur in large numbers in sections of the country where bad water exists, and during a period of four years, at which time the fire sheets are renewed, and in some instances less than three years, the staybolt breakage ranges from 30 per cent. to 60 per cent. of the horizontal installation of water space stays. In good water sections the breakage ranges from 10 per cent. to 20 per cent. in four years, and 30 per cent. to 50 per cent. in six years.

Four years ago when in the bad water section, the author ran across a lot of engines whose fire sheets were being removed on



Method of Installing Flexible Stay Bolts.

account of buckling and cracking, showing a permanent set. After closely observing the stays, which were very rigid and showing no signs of deflection, it was found that the iron was of a close, short, fibrous structure, dense and hard, proof as to high tensile strength, and the thought occurred that the fire sheets were held too rigid to allow for expansion without bending, and finally cracking. These sheets had not been in service for more than 18 months, and it was decided after discussion to apply new bolts of a material somewhat softer, of long fibrous structure, with a tensile strength of 48,000 and about 32 per cent. elongation, a good serviceable staybolt iron, and see if the new sheet of the same material would buckle in like manner. This was done, and two and a half years later the sheets were as straight as could be expected, considering the hard water condition, showing no permanent set nor indication of cracks, although a few broken stays had been renewed.

It is of the most vital importance to the success of the flexible water space stay that good work be always done in the installation of the complete bolt. There is no excuse for leakage when proper attention is given to methods of installation of a flexible stay, and in tapping the taper holes, which are made in the outer sheet to receive the sleeves, such should be carefully inspected and all

plugs and sleeves screwed up to a steam tight fit, and all plugs and all caps which make their seat on the end of sleeve should be screwed up tightly, using graphite in the threads, for by the unscrewing of the caps we are allowed to inspect the staybolt proper, when thought advisable.

Tools for installation are shown on tool sheet, also method of removing old rigid water space stays and enlarging the holes in outer sheet for flexible stays.

Referring to tool sheet, Fig. 1 is the method of removing the old bolt by using an enlarged twist drill, following the prick punched center of old bolt, drilling through outer sheet and using a reduced diameter of drill through inner sheet, collapsing the end (C), or separating such by a Wagstaff drill, leaving the hole in outer sheet enlarged ready for roughing reamer for the flexible staybolt sleeve.

Fig. 5 is a butt mill, which enlarges the hole in like manner, from tap drill size.

Fig. 2 is a roughing reamer (B), with guide bar (A), to be used in air drill to quickly straighten and size the hole in outer sheet.

Fig. 3 is a finishing reamer, with guide bar, for exactly sizing each hole previous to tapping.

Fig. 4 is a taper tap with guide bar, ¾ inch taper to the foot, 12-V threads, for finish tapping the hole in outer sheet to receive the sleeve.

Taper tapping differs from straight tapping. The reamed hole should always be of exact size for the tap to give good full threads. The tap should not be used to enlarge the hole, for this process is both unmechanical and detrimental to the tap.

A straight tap of the right diameter used before the taper tap, facilitates the tapping operation and relieves the taper tap from great strain and clogging.

Fig. 6 shows the method of tapping the inner sheet with the regular staybolt tap to aline with the installed sleeve. A cap (B) of the style (D) flexible stays is used as a means for holding the bushing (C), which holds the shank of the tap in line.

The sleeve is screwed into the outer sheet by the stud nut shown in Fig. 8, and as it takes nearly two turns to make a steam-tight fit, after the sleeve just fills the tap hole, it is necessary that the tapping operation should be gaged accordingly.

Fig. 7 shows the style (D) both installed ready for riveting over the end (F). B is a cap such as is used for the flexible stay, cut away for the admission of a dolly bar, bucking tool or holder-on. This cap protects the sleeve face where the cap makes a steam-tight joint during the riveting operation.

The dolly bar or holder-on is made of a piece of axle, 4 or 5 in. in diameter. C is a tool steel plug inserted therein, hardened and tempered.

The style of bolt here shown can be put in place with an alligator wrench on the firebox end or by means of a slot in the head.

Flexible staybolts should not be installed alternately, which has been done in some cases, for it is but a short time before the rigid water space stay has to be taken out and the flexible stay incorporated to effect a sensible installation.

There is no rule to apply regarding the selection of the installation for flexible water space stays other than to cover completely the natural breaking zone of each style fire-box.

The cost of flexible stays range from 40 cents to 70 cents a piece, complete, with bolt.

The cost of installing the flexible water space stay with proper tool equipment and systematic methods should not exceed 25 cents per bolt, and when installed in large quantities the cost should be as low as 15 cents per bolt.

In comparing the relative cost of maintaining a fire-box for four years having rigid staybolts in which the breakage amounted to 40 per cent. with a similar box in which 40 per cent. of the bolts were flexible the author showed that the outlay for staybolts in the former would be $600 as against $328 for the latter.

The stresses which tend to rupture a staybolt are:—That which operates to tear the bolt apart, the tensile stress; that tendency to break it, transversely or cross wise, due to expansion of fire sheet, the transverse stress; and that due to shear which tends to strip the threads from the bolt and hole in the sheet.

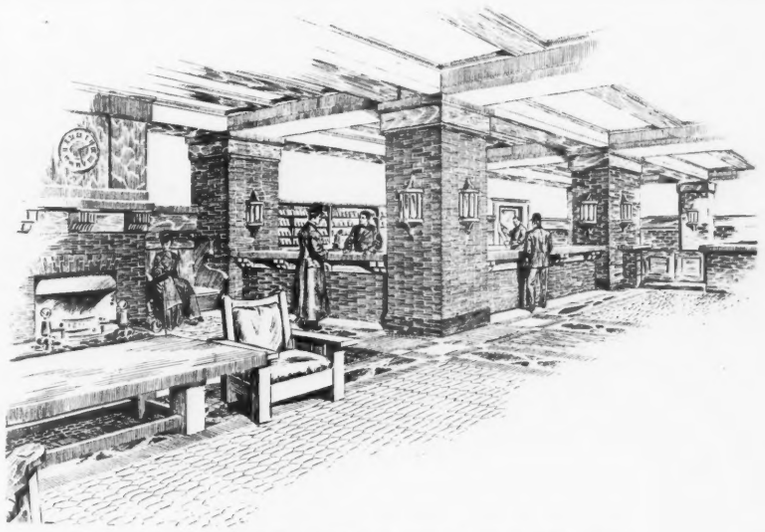
The fact that staybolt breakages have in no sense diminished, regardless of the quality of iron used and the many modifications of the forms devised in the rigid stay in the effort to provide flexibility, notwithstanding that water spaces have been widened, leads us to conclude that the fire-box as now constructed is too rigidly stayed to allow of economic and safe working where cost of maintenance of the complete machine is more or less affected in consequence of the expense accruing from the fire-box and staybolt charges of repairs incident to the constant disintegration and destruction of material, the result of shock, strain, vibration, corrosion and heat.

The force which works on the fire sheet in its course of expansion, due to high temperatures of furnace heat, throws a stress on the uttermost fibers of the rigid staybolt far in excess of the tensile stress, and as it is a reversal or vibratory stress the effect on the structure of the staybolt iron is too severe to warrant safe conclusions as regards maintaining a reasonable factor of safety.

The transverse stress breaks the rigid staybolt, not the tensile stress, and to enable the expansive forces to take their natural course with least resistance the flexible staybolt has been designed as a water space stay, as the most perfect means of affording and maintaining flexibility under all conditions of fire-box service, adding to the life of both sheet and staybolt.

New City Ticket Office of the Alton at Chicago.

A short time ago the Chicago & Alton moved its Chicago city ticket office into new quarters in the Rector Building at the corner of Clark and Monroe streets. The design and arrangement of the office is quite unique in character, some idea of which is conveyed by the accompanying engraving. The idea dominating the interior design was to give to it the appearance of a comfortable waiting room and office in a railroad station, the treatment of the walls, the design of the furniture and the general arrangement being in accordance with this idea. The color scheme harmonizes with the green granite base and the Bedford stone of the exterior of the building. The woodwork is weathered oak of a gray tone and the wainscot and piers are red brick laid in white mortar.



New City Ticket Office of the Alton at Chicago.

The ceiling is sand float plaster finished in white enamel and treated with heavy oak beams. The floor is of vitreous tile in colors to harmonize with the rest of the interior. There is a commodious fire-place with logs, andirons and built-in seats, a large table with top 8 in. thick, and numerous easy chairs, all in Mission style. Above the fire-place is a clock with delft dial and white enamel hands and figures. The metal work of the electric light fixtures is finished in verde antique bronze, the fixtures being of special design. Other features of the office are in keeping with those described, the general effect of the interior being most pleasing.

Railroad Decisions in July.

The following decisions in railroad cases were handed down by the United States Supreme Court and the Federal courts during July:

Protection of cars undergoing repairs.—A car repairer assumes the risk of injury by working under a car liable to be moved by contact with other cars, where he fails to protect himself by signals as required by a rule of the company. Canadian Pacific Railway Co. vs. Elliot, 137 Fed. Rep. 904.

Liability of lessor railroad.—The Ohio statue requiring a railroad company leasing its railroad jointly liable with the lessee on all right of action accruing to any one for any negligence or default growing out of the operation or maintenance of the road or in any wise connected therewith applies only to liabilities growing out of its duties as a carrier and not out of its duties as an employer. Beltz vs. Baltimore & Ohio R. Co., 137 Fed. Rep. 1,016; Axline vs. Toledo, Walhonding Valley & Ohio R. R. Co., Fed. 169.

Fellow servants.—A railroad section hand working on a rail-

road dump car and the engineer on the locomotive attached thereto are fellow servants. O'Connor vs. Atchison, Topeka & Santa Fe Ry. Co., 137 Fed. Rep. 503.

Engineer killed by landslide.—The death of an engineer caused by a landslide encountered in the night while running through a mountainous country is to be charged to accident for which the company cannot be held liable and is a risk assumed by deceased. Kinzel vs. Atlanta, Knoxville & Northern Ry. Co., 137 Fed. Rep. 489.

Fellow servants.—A fireman on a passenger engine is a fellow servant of a conductor of passenger train approaching in an opposite direction for whose negligence, causing the death of the fireman, the railroad is not responsible. Crosly vs. Lehigh Valley Railroad Company, 137 Fed. Rep. 765.

Georgia "tracing act."—The action against a railroad company under the Georgia statute known as the "tracing act," which requires a connecting carrier to trace and locate the prior carrier responsible for injuries to goods in transit is one for a penalty and cannot be converted into one on contract by amending a declaration. Venable Bros. vs. Louisville & Nashville R. R. Co., 137 Fed. Rep. 981.

Delayed trains.—A rule of a railroad company requiring a flagman to be sent out immediately when a train is delayed so that it may be overtaken by another will apply to a transfer train of another company using the main tracks of the company promulgating the rule running on the time of a passenger train. Northern Pacific Ry. Co. vs. Cummisky, 137 Fed. Rep. 508.

Railroad aid subscription.—Where the subscription provides that the selectmen of the town are authorized for and on the behalf of the town to contract with the railroad company which contract shall embody the terms and condition of the vote, the making of the contract is merely authorized and not required to entitle the receiver of the railroad to the benefit of the subscription on compliance with the terms of the vote. Paige vs. Town of Rochester, 137 Fed. Rep. 663.

Interstate Commerce Commission.—A Federal circuit court will not suspend the operation of a decree entered in a suit brought by the Interstate Commerce Commission under the provision of the statute enjoining railroad companies from violating an order of the commission affecting rates pending an appeal therefrom, where it does not appear that the damage to defendants from its enforcement will be greater than that which would result to shippers from its suspension. Interstate Commerce Commission vs. Southern Pacific Co., 137 Fed. Rep. 606.

Presumption of negligence.—Injuries to a passenger by the derailment of a car in which he was riding while passing over a switch creates a presumption of negligence on the part of the carrier. Michigan vs. Grand Trunk Western Ry. Co., 38 Fed. Rep. 37.

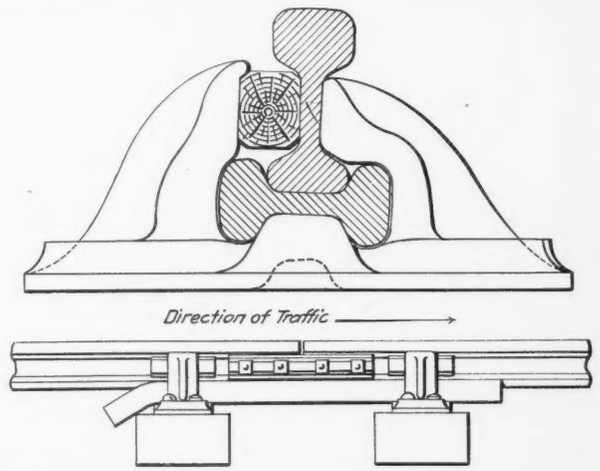
Release of damages for injuries.—Mental impairment and partial loss of sight from injuries by a railroad employee in a collision are not covered by a release, which after enumerating the injuries sustained as "bruises of his body, right leg and right arm, and a scalp wound," recites that "to maintain amicable and pleasant relations and avoid all controversy in respect to said matter," and for a monetary consideration the employee releases the railroad company from all claims of any kind and character whatsoever arising from the injuries and damages sustained in the manner or upon the occasion aforesaid, and the results of those injuries. (U. S. Supreme) Texas & Pacific Railway Co. vs. Dashiell, 25 Supreme Court, Rep. 737.

Taxation of railroads.—A statute does not violate the fourteenth amendment of the Constitution of the United States because it provides a method of taxing railroads different from that applied to the property of other corporations or individuals, although the latter may incidentally own or operate railroads. Michigan Railroad Tax Cases, 138 Fed. Rep. 223.

Speed at crossing.—A person approaching a railroad crossing in a city is not bound to anticipate that an approaching train will proceed at an unlawful or unusual rate of speed. Farrell vs. Erie R. Co., 138 Fed. Rep. 28.

Experimental Supported Rail Joint on the North Eastern.

The accompanying illustrations show with great clearness an odd form of supported rail joint that is being tried on the North Eastern Railway, England. Sections of old 82 lb. rail are laid on their sides, between the foot of the 90 lb. standard bull-headed rail



Cross Section, North Eastern Supported Joint. (The Lower Cut Indicates a Variation.)

and the specially constructed chair. These special chairs weigh 60 lbs. each. The chair fastenings, fish plates and bolts are the regular North Eastern standard. It will be seen that the fit of the standard 90 lb. section into the side of the old 82 lb. is quite excellent, although this would presumably not hold true with other weights.

A Unique Way of Supporting a Rail Joint; North Eastern Railway.

GENERAL NEWS SECTION

NOTES.

Automatic block signals are being put up on 71 miles of the Union Pacific between Green River, Wyo., and Table Rock.

The Wabash Railroad is to abandon the pay car and pay employees by means of checks, which will be sent to division officers and to agents for distribution.

A press despatch from Montgomery, July 30, says that the Alabama Railroad Commission has ordered substantial reductions in freight rates on all the railroads of the state.

The grain elevators of the Great Northern at Duluth have been leased to A. D. Thomson & Co., a large grain firm. The total capacity of the three elevators is 6,500,000 bushels, one alone having a capacity of 3,000,000 bushels.

The city authorities of Atlanta, Ga., have notified the railroads that henceforth the state and city laws forbidding the movement of freight cars on Sunday, except those containing perishable freight, will be enforced in the Atlanta yards.

A press despatch from Washington says that the amount of money paid into the treasury in two weeks by railroads, in the shape of fines for violating the 28-hour live stock transit law, was $20,000. This probably represents 200 violations.

On the evening of July 24 one of the regular express trains of the Pennsylvania Railroad from Broad street, Philadelphia, to Atlantic City, ran through in 63 minutes, the distance being 69.4 miles. Stops were made at West Philadelphia and North Philadelphia.

The State Board of Health of Indiana has promulgated a sanitary code for railroads. Day coaches must be cleaned at the end of each trip. In no case shall they be uncleaned longer than two days. In all waiting rooms notices prohibiting spitting must be posted.

At the "Traction Terminal Station" in Indianapolis six electric railroads now have freight stations. The Indianapolis & North-Western runs freight cars eight times daily between Indianapolis and Lafayette and the same number between Indianapolis and Crawfordsville. Each of the electric roads has a freight agent at the terminal.

The Supreme Court of Florida has affirmed the decision of a lower court holding unconstitutional the law recently passed in that state requiring the separation of the white and black races in street cars. The act is declared invalid because, in permitting negro nurses in charge of white children to ride with the whites, it discriminates between persons.

One of the news items lately appearing in the daily press, which isn't so, is that speed indicators are to be put into cabooses of the Delaware & Hudson. For a long time, until a few years ago, speed indicators were in use in the freight cabooses of that road, but they have been taken out, and an officer of the road informs us that there is no intention of replacing them.

The contract which the Union Switch & Signal Company has taken for automatic block signaling on the Lake Shore & Michigan Southern, recently noticed in the *Railroad Gazette*, is for about 400 miles of line, all of it double track, except short pieces on which there are four tracks. The amount of the contract is more than $1,000,000, said to be the largest signal contract ever made.

At Tribes Hill, N. Y., on the New York Central, one day last week six men in a work train gang were killed by a passenger train, and three others fatally injured. The men were leveling sand which had been dumped along the track, and when they stepped out of the way of a westbound freight train stepped in front of an eastbound passenger. It is said that the sand was so whirled about by a high wind that the view of the approaching train was obscured.

The Railroad Commissioners of Texas are to hold a public hearing on the question of rates for refrigeration in refrigerator cars. Some investigation has been made already, and it is said that one contract shows that a Texas line pays the American Refrigerator Transit Company 1 cent a mile for all its refrigerator cars handled, loaded or empty; gives its employees free transportation and the company the free use of the railroad telegraph wires, and then pays it 12½ per cent. of the gross freight earned by the cars.

Cement rock has been discovered in New York City, or at least so it is asserted by a reporter who has found large piles of the rock around the shaft in which is being sunk the caisson for the Pennsylvania Railroad tunnel at the foot of East Thirty-fourth street, Manhattan. The deposit of rock was found by the tunnel diggers about 100 ft. below the surface and large quantities have already been taken out. The reporter says, however, that the contractors and workmen on the tunnel refuse to give any information as to the origin of the rock.

The prescribed time for running a freight train over the Middle division of the Pennsylvania Railroad, which has been 22 hours, has been changed to 18 hours. The length of this division is 132 miles, Harrisburg to Altoona; which indicates that the time named is that allowed for a round trip. At 15 miles an hour a train needs nearly nine hours to run over the division one way. At 20 miles an hour the running time would be 6 hrs., 36 min. This, under an 18-hour schedule, would allow the crew about five hours for rest at the far end of the division. A similar change has been ordered on the Pittsburg division, which extends from Altoona to Pittsburg.

The Chicago, Rock Island & Pacific is trying an experiment to head off the construction of an electric line between Des Moines, Iowa, and Indianola. Heretofore three passenger trains have been run each way daily, but commencing July 23 the company began running six trains each way daily, or every three hours. The officials are evidently exercised by the encroachments of the electric interurban lines. During the past three years two interurban lines have been built in Iowa paralleling the Rock Island, one from Des Moines to Colfax, 23 miles, and the other from Iowa City to Cedar Rapids. In both cases the interurban lines have taken over about all of the local passenger and freight traffic between the points mentioned, and in many instances passengers from distant points on the railroad have taken advantage of the cheaper rates on the interurban lines by stopping at one or the other of the terminals mentioned and taking the interurban for the remainder of the trip.

In the United States Court at Kansas City, August 1, the Atchison, Topeka & Santa Fe filed its answer in the proceedings lately begun by the Government against the road for contempt of court, in violating the injunction against secret rates, which was issued against all of the roads in the West two or three years ago. The complaint in the present case has to do with rates on coal shipped by the Colorado Fuel & Iron Co., which have been the subject of so much newspaper discussion in connection with the accusation of law-breaking against former Vice-President Paul Morton. The company's answer says that prior to the injunction the Atchison, having found that its competitors were secretly cutting rates, also secretly cut its own rates; that when the Interstate Commerce Commission investigated the case Vice-President Morton freely described the methods of the Atchison, in order to aid in stopping unlawful practices; that on the issuance of the injunction the traffic managers of the Atchison notified agents to comply with it, and that the unlawful tariff subsequently issued by the road was prepared by the traffic manager, who inadvertently, without any desire to avoid the order of the court, included the cost of the coal in the published prices for transportation. The payment of the shippers for their coal and the collection of the sum from the consignee was to facilitate business, and not to afford a vehicle for rebates.

Yellow Fever.

Yellow fever has prevailed to some extent in New Orleans for more than two weeks, and the total number of cases reported up to August 1 was 346. The total number of deaths in the city to that date was 62, and a few cases had been discovered in other towns, one of them in Plaquemine Parish, 100 miles from New Orleans. In consequence of the confidence now entertained by the authorities in their ability to control the disease by killing mosquitoes, the public alarm has not been so serious as in former years; but a considerable number of quarantines have been established, and many merchants have stopped ordering goods from New Orleans, so that traffic has already been seriously affected. Most, or all, of the railroads have taken off some of their passenger trains to and from New Orleans. The last yellow fever epidemic in the Southern States was in 1897.

The Chicago Teamsters' Strike.

The teamsters' strike, which terminated last week with a rush of the men to get positions with their former employers, had lasted 15 weeks. The following statistics of the strike are given by the *Evening Post*: Strike called, April 6; ended, July 23. Men thrown out of employment, 4,250. Cost to the unions, $300,000. Wages lost by strikers, $750,000. Cost of the strike to the employers, $2,100,000 in wages, and loss of business estimated at more than $12,000,000. Cost of the strike to the city, $175,000, and to the county, $100,000. Persons injured by the strike, 450; deaths, 21. To preserve peace there were 2,200 policemen, 1,400 specials, and 3,400 deputy sheriffs. The strike started over an attempt to uphold 16 little tailors who went out on a strike. There was at no time any question of wages or hours among the teamsters, but they went out on a sympathetic strike.

Royal Commission on London Traffic.

The following is a digest of the report: The Commission, appointed on Feb. 9, 1903, by Royal Warrant, consisted of Sir David Barbour, Chairman; the Right Hon. Earl Cawdor, the Right Hon. Viscount Cobham, the Right Hon. Lord Ribblesdale, the Right Hon. Sir Joseph C. Dimsdale, Bart.; Sir John P. Dickson-Poynder, Bart.; Sir Robert Threshie Reid, Sir John W. Wolfe-Barry, Sir Francis J. S. Hopwood, Sir George C. T. Bartley, Sir George S. Gibb, Mr. Charles S. Murdoch, Mr. Felix Schuster, Mr. Lynden Macassey, Secretary. The Chairman, four other members and the Secretary visited New York, Boston, Philadelphia and Washington in 1903, and studied American rapid transit.

The population of Greater London in 1901 was 6½ million persons, and the number of rides per capita per annum, by all local means of transport excluding trunk line railroads, is 200, compared with 300 in New York and 270 in Berlin, thus indicating statistically a substantial comparative deficiency. Particularly in relation to the working classes, facilities for locomotion are deficient. Under existing conditions, the serious over-crowding in the central districts of London cannot be alleviated; the population per acre in those districts is 148, in the rest of the county of London 54; in districts adjacent to the county 16.6; and in the rest of "Extra London" 2.5. Upwards of 1½ millions of persons live in the central districts. In the central districts the average weekly rent of newly-erected working class houses is 3s. 3½d. per room, in the rest of the county 2s. 4½d., and in "Extra London" 2s.

The only difficulty in the way of completely reorganizing London for purposes of locomotion is, the Commission says, the question of cost. The ideal scheme is the construction of railroads in London for purposes of long distance urban traffic, and of railroads radiating to the suburbs for purposes of suburban traffic, connected with tramways for short distance distribution; the widening of existing and provision of new streets for local urban traffic, and the regulation of street traffic to prevent or reduce congestion, and the provision of complete facilities for passenger interchange. The most important proposal calls for the construction of two main avenues through London, one 4¾ miles from west to east to connect Bayswater Road with Whitechapel, the other 4½ miles north to south to connect Holloway with the Elephant and Castle. Each avenue would be 140 ft. in width, from house to house, with subways for water mains; with four lines of tramway on the surface, and four lines of railway below the surface, for express and local stopping trains. The east and west avenue, with its subways, railways, and tramways, is estimated approximately to cost about £15,550,000, and the north and south avenue about £8,550,000 net.

The Commission, after consultation with the Advisory Board, recommends that new streets or widened streets should forthwith be laid out according to the following standards of width from house to house: Main avenues, 140 ft.; first class arterial streets, 100 ft.; second class streets, 80 ft.; third class streets, 60 ft.; fourth class streets, 40 or 50 ft.

As regards tramways, even where they now exist there is an entire absence of through communication between the systems, and every through passenger is obliged to change cars at the junctions, if any, of the various systems. Accordingly, all the cars are obliged to discharge their passengers at dead-end terminals. At the six principal terminals nearly a quarter of a million of passengers alight from, or join the cars every day in the streets. Apart from the great inconvenience caused, the result is a very great congestion, both of tramcars, and of ordinary vehicular and pedestrian traffic, at these terminal points. The Advisory Board of Engineers estimates that the carrying power of a tramway system may be diminished by about one-half by reason of the cross-shunting necessary at dead-end terminals. It will be seen that, from every point of view, tramway accommodation is glaringly defective. In a great area, there is no tramway service at all. It is difficult to appreciate how such a state of things can have been tolerated so long.

In smaller cities, tramways supply a double want. They carry passengers from one part of the city to another, and also between the city and adjoining areas, to a distance of eight or ten miles. In London, it is probable that their usefulness will be more restricted. They will be chiefly used for short distances in urban and suburban districts. Experience shows that the metropolitan railways, even where no tramways compete, practically do not attract passengers for journeys of less than a mile. Railways and tramways can, with advantage, be worked in inter-connection. "Tubes" might be prolonged till they reach the surface, at some point in the more open country, and then be continued on the surface to the suburbs.

The competitor of the tramway for short distance traffic is the omnibus, and the horse omnibus, it is said, will always serve a useful purpose in London, unless superseded by the motor omnibus, in distributing passengers where tramways do not penetrate, but the Commission believes that on all the routes, where there is fair competition, the same thing will happen in London as happened in Liverpool between the years 1897 and 1903. Within a period of seven years all the omnibuses disappeared from the streets and gave place to electric tramcars, while the number of passengers carried was nearly trebled. Few would object to an extensive tramway system being laid down all over London, but for the belief that it must involve an extensive system of street widening. This is the great difficulty.

Judged by the standards of width, many of the main thoroughfares of London will admit of tramways. Of course the decision must depend partly upon the extent to which the street is crowded, as well as upon its width. Certainly some street improvement is necessary in places, from any point of view. Through communication, without rebooking or trans-shipment of passengers, is of great importance, and it is desirable that all tramway systems within Greater London ought to be worked by one and the same authority. The Commission does not deal directly with the question of the municipal operation of tramways, but considers it reasonable that some profit should be derived from the tramways for the benefit of the municipality. It does not follow that the best way of securing the largest profit will be that the municipality, even if it finds the money for construction, should undertake the task of operating.

The Commission strongly recommends the consolidation of the tramway and light railway laws, and would abolish the veto power of local and street authorities and of frontagers, and provide that, in Greater London, the County Councils and the Corporation of the City of London shall have a preferential right to construct any tramways, within their districts, if they are prepared to do so.

The needs of London in the matter of railroad accommodation, according to the report, are:

(1.) Main trunk railroads connecting London with the entire railroad system of the country, with adequate running and terminal accommodation, and sufficient services for the convenient and speedy conveyance of long-distance passengers, and for the carriage of merchandise traffic.

(2.) Railroads to every suburban district in the neighborhood of London, with full running accommodation to enable trains to be run at quick speed and short intervals, especially during "rush hours."

(3.) Railroads in, through, across, and round the center area of London, to provide, not only for urban movement at higher speeds, and for longer distances than those which can be conveniently provided for by street tramways and omnibuses, but also for the distribution of suburban and long-distance passengers to the fullest practicable extent.

The needs of urban and suburban traffic are, the Commission points out, wholly different in character, and many of the mistakes of the past have been due to not keeping this distinction in mind with sufficient prominence. The considerations affecting location, accommodation and working of urban and suburban railroads are radically different, and, to some extent, conflicting; and the absence of comprehensive design in the railroad system in London is nowhere more apparent than in the confusion which has arisen from not distinguishing, with sufficient clearness, between the requirements of these different classes of traffic. Railroads intended for urban traffic have been used, and partly designed, for suburban traffic to an extent, and under conditions, which have adversely affected their utility for both purposes. It is of vital importance not to attempt to use urban railroads in any way, or for any purposes, which may prevent the running on them of train services of maximum frequency.

With regard to the building of further "tubes," the Commission believes that a sufficient number of successful underground railroad schemes remain to justify the hope that there is no need, as yet, to make an alteration in the present system of private promotion in the direction of looking to public sources for any part of the funds required for railroad enterprise, unless undue financial obligations are thrown upon the railroad undertakings, either in respect of works or compensation, or in regard to the carriage of passengers at unremunerative fares, or otherwise.

If public assistance is inevitable, the Commission suggests various methods of assistance—the remission of rates, direct subscription to capital or guarantee of receipts by local authorities, permission to railroad companies to acquire large tracts of land before development, and, in cases, permission for construction underneath the parks.

The existing defects of the means of locomotion and transport in London are, in the opinion of the Commission, due mainly to the haphazard manner in which questions connected therewith have been treated in the past. The streets were not originally laid out on any general plan, nor were they made of sufficient width. No general and systematic improvement of the streets of London has ever been attempted, and the works carried out have not been sufficient to meet the ever-growing wants of the population, and the construction and maintenance of the main roads leading out of London have never been properly controlled or regulated. Under such conditions the best results could not be obtained. The method of obtaining Parliamentary sanction is both costly and inefficient without any attempt to bring proposal into harmony with a gen-

eral and comprehensive scheme of locomotion for London. Railroads of all classes have been practically left to private promoters, subject to such regulation as could be enforced by the intermittent control of Select Committees of Parliament. The only effective remedy appears to be the creation of a permanent authority, possessed of special knowledge and experience, and giving continuous attention to all questions affecting locomotion and transport in London.

It would be impossible to confer the necessary powers, with jurisdiction over the whole of Greater London, which extends into five adjoining counties, on the London County Council or any other existing local authority or body, and the creation of a new authority, empowered to deal finally with all questions of London locomotion, would involve intolerable interference with the existing local authorities, and give rise to endless friction. Nor would it be possible to entrust such powers to a new and elected authority, without an interference with existing institutions, so violent as to amount almost to a municipal revolution.

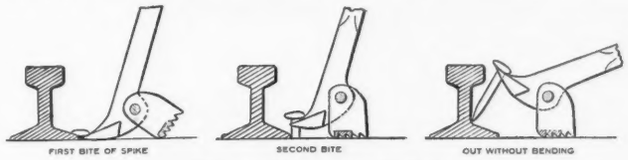
The authority which the Commission recommend to be established should be a Traffic Board, and should discharge definite and practical duties. It should make a yearly report to Parliament on locomotion, transport and traffic in Greater London, dealing with the whole subject, including such matters as the control of traffic, the provision of new lines of railway or tramway, etc. It would also deal with the question of street improvements. The most important function of the Board would be the preliminary examination, before consideration by Parliament, of bills seeking statutory powers for the construction or extension of works affecting the means of locomotion and transport in Greater London. The board would sit continuously, and bills that required serious amendment could remain before the Board until the necessary antecedent formalities were completed.

It might also hear and determine all disputes relating to through running or the interchange of traffic on or between railroads and tramways, and could perform a useful service by facilitating and suggesting amalgamation or joint working under suitable conditions. The services of the Board would be valuable in connection with the abolition of the "veto" in the case of tramways, because the existence of such a body would, at any rate, lessen the objection to such a measure on the part of the authorities now possessing the "veto."

It will be seen that the functions of the Board are of an advisory and semi-judicial character, and do not, as recommended for the present, involve the exercise of executive or legislative authority. What is required for such purposes, in the opinion of the Commission, is a small number of specially-qualified persons, selected solely on the ground of their competence, and holding office for a considerable period.

The Justice Spike Puller.

The accompanying illustration shows the action of the Justice spike puller, made by P. S. Justice & Co., 421 Chestnut street, Philadelphia. The bar starts the spike in the ordinary way, then the handle is thrown up and the trig falls down, giving a new bite for the second pull. It is claimed that the spikes are never bent, and can be drawn in half the time taken with the common claw bar. The weight of the puller is 30 lbs.



The Justice Spike Puller.

Disastrous Collision of Electric Cars at Hall Road, England.

Press despatches of July 27 report a collision, on the evening of that day, on that portion of the Lancashire & Yorkshire which was recently electrified. An express train from Liverpool for Southport ran into a standing train of empty passenger cars. The leading car of the express was crowded and 23 persons were killed. Many were injured, most of them slightly. The body of the first car was lifted off the frame and fell back upon the passengers. The wreck took fire at once and many of the passengers were burnt. This is the most serious accident reported on a British railroad since the Armazh disaster of 1889, 16 years ago.

The local service from Liverpool ends at Hall Road, and the train service consists of local trains from Liverpool to Southport every 20 minutes, with a local stopping service from Liverpool to Hall Road in between, so that there is a 10-minute service from Liverpool to Hall Road. Express trains running without a stop from Liverpool to Birkdale (part of Southport) run every hour, and it was apparently one of these trains that ran into one of the Liverpool-Hall Road local trains.

All the trains consist of four cars, two first class (in the center) and two thirds. At the busy hours when the city men are returning to their homes the carriages are crowded and this probably accounts for the big death roll.

The line is properly protected by the absolute block system and fixed signals with distant signals the regulation distance out (at least 1,800 ft. from the stop signal is the Lancashire & Yorkshire rule). The line is quite open at this point and consequently the collision must have been due to either the towerman's error in allowing the express to approach or to the motorman losing control. It is hardly likely that the man overran his signals, as under English rules he would have to pass two sets of signals—one at the tower in the rear and those protecting the standing train.

It may be interesting to state that there are no automatic signals on this road. Whilst the Lancashire & Yorkshire has done considerable with track-circuit and has put down a set of the Westinghouse automatic signals, yet nothing of the kind has been done on the Liverpool-Southport line, nor are there any automatic stops. Possibly had there been such an appliance the accident would not have occurred or its results probably would have been modified. There are, however, difficulties in the way of the provision of such safeguards on the Southport line. For instance the freight traffic is still worked by steam power; also another company, the London & Northwestern, has running powers over the greater part of the line and its trains are worked by steam.

It may be stated in connection with this matter that on the Metropolitan District Railway, recently converted from steam to electricity, automatic signals have been provided throughout by the Westinghouse Brake Company, and automatic stops are also used. There is an overlap of 300 ft. and the stop is at the home signal, there being no distant signals. Overlaps are of this standard length regardless of grade and curvature of the line. But the Southport line is different. Firstly, it is all in open country with a good view of the line and signals as a rule, and were automatic stops proposed the question would arise as to where they should be placed. If at the stop signal they might not be effective in case a train was immediately on the other side of the stop signal. Then, at the distant signal they would go to opposite extremes and pull up the train prematurely and often unnecessarily, and would be bound not only to cause delay but its utility would be abused and deprecated. To fix it midway between the home and the distant signal would not meet the case, as much would depend upon the speed of the trains and the grade of the line.

This accident must be a source of great anxiety to the Lancashire & Yorkshire officers. Two years ago they had a serious accident at Waterloo near the same place, before the line was electrified, when a Southport express left the rails from some still unknown cause and several lives were lost. They have now spent a considerable sum of money in electrifying this line, an outlay which Mr. Aspinall, the General Manager, admitted at the Washington congress has not led to any reduction in expenses of working. But they are hoping to reap their reward by the popularity of the road, especially amongst Liverpool business men whom they hope to attract to reside on the Southport line. This accident must therefore have a retarding effect on these efforts and one must sympathize with the railroad company, and with Mr. Aspinall in particular, to whose personal initiative this change from steam to electricity was due.

The cars used on this line are not of steel and when the matter is fully looked at it will be admitted that the railroad company might consider that the increased expense would not be justified. The line does not run at any point through a tunnel and, as has already been said, the country is open. It hardly seems necessary then, coupled with the high average immunity from accident in England, for any such increased expense to be incurred in order to mitigate the effects of a collision. Such a conclusion may, however, be modified if it be correct that the wreckage caught fire.

Delightful Delaware.

DOVER, Del., July 18.—Seven hundred and fifty-three loaded cars of vegetables and fruits, grown on the Delaware peninsula, were moved up through Delaware and into Pennsylvania, New York and New England yesterday. It was the greatest day in history for the Delaware peninsula's business of supplying the East with fruits and vegetables, and on the little Delaware railroad, besides a heavy passenger traffic, these 30 or 40 tremendous freight trains were moved with great despatch and without accident. Peaches, although only a side issue, were in evidence everywhere. Each peach grower averaged 50 baskets. Apples were shipped from almost every Kent and Sussex shipping place of importance. Plums of several varieties made a beautiful sight as they glistened in the sunlight at three score of stations. Watermelons, cantaloupes, early grapes and garden truck were shipped in large quantities. The largest shipments to Philadelphia were of potatoes. This staple product has been overgrown in Accomac and Northampton Counties, and they are scarcely paying for the picking. So productive were the vines this year, highly fertilized with nitrate of soda and other strong plant foods, that as many as 100 bushels to the acre have been produced. It is estimated that the yield of these counties alone this year will be 1,250,000 bushels. This has already lowered the price to 75 cents a barrel.—*Wilmington News.*

Proposed Consolidation of Car Builders.

The long-pending project of consolidating the fifteen or twenty companies which build street cars in the United States is now the subject of widespread comment, and some of those interested say that the success of the project is assured. Messrs. Kean, Van Cortlandt & Co., bankers, of New York, are the managers of a syndicate which, it is said, will carry out the consolidation; and they expect to get enough subscriptions to the stock and bonds by the middle of August to assure their success. It is proposed to issue stock and bonds amounting to fifty-six millions, as follows:

30-year 5 per cent. gold bonds	$13,000,000
Preferred stock, 6 per cent. cumulative	15,500,000
Common stock.	27,500,000
Total	$56,000,000

The shops included in the consolidation are the following:

J. G. Brill Co., Philadelphia.
John Stephenson Car Co., Elizabeth, N. J.
Laclede Car Co., St. Louis.
St. Louis Malleable Casting Co., St. Louis.
American Car Co., St. Louis.
Cincinnati Car Co., Cincinnati.
St. Louis Car Co., St. Louis.
Wason Manufacturing Co., Springfield, Mass.
Osgood Bradley & Sons, Worcester, Mass.
John J. Cummings Car Co., Paris, Ill.
Jewett Car Co., Newark, Ohio.
J. M. Jones Sons, Agents, Troy, N. Y.
Laconia Car Co., Laconia, N. H.
McGuire-Cummings Manufacturing Co., Chicago.
Peckham Manufacturing Co., Kingston, N. Y.
Niles Car Manufacturing Co., Niles, Ohio.
Journal Bearing Co., St. Louis.
Easy Access Door Co., Boston.

The average annual net earnings of the companies named for four or five years past aggregate $1,263,391, and the last year's net earnings were $1,381,710. It is estimated that the net earnings of the new company for the first year will be $2,400,000. It is said that the present owners of the plants will take at least $15,400,000 of the bonds and stock, or $8,500,000 of the bonds, $10,300,000 of the preferred and $6,300,000 of the common stock. Edward Harrison Power and William T. Van Brant have been the principal promotors of the scheme for consolidation. It is estimated that the production of the consolidated plants will be about $15,000,000, on which a saving of 10 per cent., or $1,500,000, is expected to be made by reduction of expenses, and the company will save the expense of considerable litigation, which in the past has been the cause of much loss to the constituent companies.

A number of the plants are equipped for turning out freight cars, steam railroad cars and steel street cars. It is announced that Martin Brill, of the J. G. Brill Co., of Philadelphia, has consented to become the president of the proposed company.

Passes for Southern Pacific Employees.

On the Southern Pacific Lines in Texas passes are now given to train despatchers, station agents, conductors and engineers, as follows:

To those who have served over ten years and less than fifteen years, annual passes for each over the division on which he is employed.

To those who have served over fifteen years and less than twenty years, annual passes will be issued to each for himself and his wife over the division on which he is employed.

To those who have served more than twenty years, annual passes over the entire system will be issued to each for himself and the members of his family dependent upon him.

Increase of Wages on the "O. W."

The New York, Ontario & Western has increased the pay of freight enginemen on large engines from $4 a day to $4.25; enginemen on other engines from $3.75 to $4. Conductors, both passenger and freight, are advanced 10 cents a day, passenger conductors now receiving $3.60 and freight conductors $3.30. Firemen are advanced 10 cents a day, and will now receive on large freight engines $2.60; on passenger engines, $2.20, and on switching engines $2.20. Brakemen are advanced 10 cents, to $2.30.

Passes and Bribery.

A railroad manager, quoted by the *Wall Street Journal*, says that the liberal use of free passes among legislators and public office holders is necessary to prevent hectoring legislation; that if every railroad corporation in the State of New York should cut off every annual pass that it has issued to people in public life and discontinue its trip passes, before another year had passed there would not be a train running faster than 20 miles an hour, and it would cost one-third more for operating expenses; and there would be a flood of municipal and state legislation enacted that would practically tie up the railroads; not that such legislation is needed, but it would be passed and enforced because the passes were not issued.

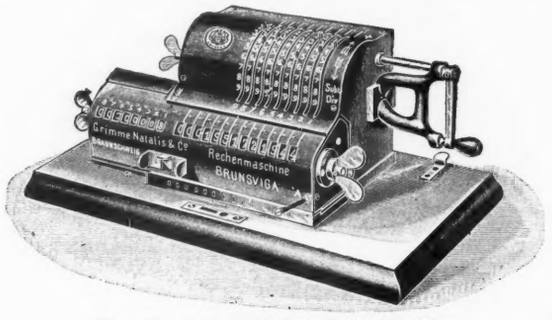
Perhaps this railroad manager thinks that the people would submit to such conduct on the part of their representatives, but he is mistaken. No doubt the free pass secures immunity from petty blackmailing efforts in legislative bodies, but probably the railroads keep up the bribery rather to prevent legislation of a justly reformatory kind.—*Springfield Republican.*

Electric Train Service on the Long Island.

The electric train service on the Long Island Railroad from Flatbush avenue to Rockaway Beach was inaugurated July 26. Twelve round trips were made and a total of nearly 5,000 passengers carried. The first train left Rockaway Park at 7.55 a.m., arriving at Flatbush avenue, a distance of 16 miles, in 35 minutes, after making 13 stops. This is about five minutes less than the running time under the steam schedule. As soon, however, as the work now in progress of removing the remaining grade crossings is completed, it will be possible to reduce the time of the trip still further. The next section of the road to be operated by electricity will be the line from Woodhaven Junction to Jamaica and Springfield. This, it is expected, will be ready very soon. Later in the year it is probable that electric trains will be running on the North Division, through Flushing to Whitestone and Port Jefferson.

The Brunsviga Calculating Machine.

The accompanying illustration shows a form of mechanical calculating machine which is in extended use in Europe and has been introduced in a number of large commercial offices in this country. It performs the four principal functions of arithmetic, multiplication, division, addition and subtraction, and is adapted for much more complex calculations such as square root, foreign exchange, ratios, etc. It is simple and strong in construction, cannot get out of order and it is claimed that learning its manipulation is only a



The Brunsviga Calculating Machine.

matter of a few minutes practice. After having "set" the necessary figures for the calculation on the cover plate by means of the small levers, the working consists of turning the handle at the side and moving the lower figure case or slide. The figures are always visible during a calculation and if a mistake is made it can at once be rectified by turning the handle in the opposite direction, thus avoiding the necessity of commencing again at the beginning of the calculation. The machine is especially adapted for multiplication and division, and is, of course, absolutely accurate. It is made in three sizes, having 18, 13 and 9 figures respectively for the products. The larger sizes are fitted with a bell which rings when the calculation is beyond the capacity of the machine. The machines are made by Grimme, Natalis & Co., Lim., of Brunswick, Germany, and are sold in the United States by Felix Hamburger, 90 William street, New York.

Manufacturing and Business.

The Philadelphia & Reading Coal & Iron Co. is making plans for putting up a new modern coal storage plant at New Bedford, Mass., in addition to the present one.

A quarterly dividend (No. 154) of $2 a share from net earnings has been declared by the Pullman Co., payable August 15 to stockholders of record at close of business July 31, 1905.

The South Atlantic Car Manufacturing Co. is reported to have bought the plant of the Georgia Car & Manufacturing Co. at Savannah, Ga., and will begin equipping and operating it at once.

The Missouri, Kansas & Texas cars, the specifications for which were printed July 21, will be equipped with Trojan couplers. A typographical error in the previous item had it "Logan" couplers.

The Berwind-White Coal Mining Co., it is said, has bought 50 acres of ground near Hollidaysburg, Pa., to be used as a site for building new works. The company will make steel cars to be used to transport coal from its mines.

R. D. Hunter, formerly District Manager of the Sullivan Machinery Co. at Denver, Col., has been made General Sales Manager, with headquarters in the Railway Exchange Building, Chicago. W. P. J. Dinsmor, of the Denver office, succeeds Mr. Hunter as District Manager at that point. Matthew Brodie, formerly of the Pittsburg office, has been appointed local manager of the Salt Lake branch, with offices at 128 Keith Building.

The Westinghouse Electric & Manufacturing Co. has booked orders from Nelson Morris & Co. for 19 new type induction motors and

from the Decatur Car Wheel & Manufacturing Co. for eight motors of the same type; also from the Illinois Steel Co. for 80 direct-current railway type motors; from the Hawaiian Electric Co. for two 1,200-kw. three-phase 2,200-volt engine-type generators, and two 125-kw. exciters and seven 500-kw. oil-insulated self-cooling transformers; from the Rumford Falls Power Co. for one 550-kw. and one 800-kw. alternating-current generators, two 450-h.p. variable-speed induction motors and 120 transformers.

The J. G. Brill Company has just booked an order for 35 semi-convertible cars for the Memphis Street Railway. The cars were ordered through the engineering firm of Ford, Bacon & Davis, of New York City. The semi-convertible system includes the recent improvement eliminating the sash trunnions and runways formerly used and simplifies the method of connecting each pair of sashes. The arrangement is known as the "Grooveless Post Semi-Convertible," and has been specified in recent orders from Philadelphia, Boston, Baltimore and elsewhere. The general plan of the lower sash carrying the upper into pockets in the side roofs is preserved. The cars are for fast and heavy city and suburban service. They will measure 30 ft. 6 in. over the end panels and 42 ft. over all.

Iron and Steel.

The American Bridge Co. has ordered 25,000 tons of structural material in the last few days. Part of the order, amounting to 7,000 tons, is for the frame work of the American Express Co.'s building at Trinity place, New York.

The Maryland Steel Co. recently shipped from Sparrows Point, Md., a cargo of railroad material for Cuba. The cargo was valued at more than $100,000 and included 11,135 steel rails, 4,666 bundles of splice plates, 394 kegs of spikes, bolts, etc., and 11,920 reels of barbed wire fencing.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, see advertising page 24.)

Car Foremen's Club.

The place of meeting for this club in Chicago has been changed to 26 Van Buren street, Room 218. The next regular meeting will be held there August 8. P. H. Eskridge, Secretary.

Traveling Engineers' Association.

The thirteenth annual convention of the Traveling Engineers' Association will be held in Detroit, Mich., beginning September 12. Headquarters will be at the Cadillac Hotel, and the meetings will be held there. W. O. Thompson, Oswego, N. Y., is Secretary.

St. Louis Railway Club.

This club held no meeting in July. The *Proceedings* for that month contains the paper on the cost of construction of telephone lines on railroads, by F. F. Fowle, of the American Telegraph & Telephone Company, which was read before the Railway Telegraph Superintendents' Association last May.

Master Car and Locomotive Painters' Association.

The 36th annual convention of this association will be held in Cleveland, Ohio, Sept. 12 to 15, 1905. Headquarters will be at the Hollenden Hotel. Eight subjects relating to car and locomotive painting will be considered in committee reports and individual papers. Robert McKeon, Secretary, Kent, Ohio.

PERSONAL.

—Mr. George Demarest, formerly Treasurer of the Master Car-builders' Association, died July 19. Mr. Demarest had been master car builder on the Camden & Amboy, and later was on the Pittsburg, Fort Wayne & Chicago.

—Mr. H. A. Childs, formerly Master Mechanic of the Erie at Jersey City and later Superintendent of the Fitz-Hugh Luther Co.'s plant at Chicago, has been appointed Superintendent of Motive Power of the Guayaquil & Quito Railroad, Ecuador.

—Miss Rebecca S. Bracken, who died at her home in Niles, Mich., on July 20, had been telegraph operator at the Michigan Central station in that city for 40 years. She was a very efficient telegrapher and was held in the highest esteem by the officers of the road, the employees and the public. Miss Bracken is referred to by reporters familiar with railroad men in Niles, as the "railroad angel," and from the expressions of esteem and regard published in the *Niles Daily Sun*, and elsewhere, it is evident that this characterization was not an empty compliment. She was not only competent and faithful at her work, and uniformly courteous, but manifested such marked feminine virtues that she was known and respected in all the circles with which she came in contact.

—Mr. J. E. Greiner, who has been recently appointed Assistant Chief Engineer of the Baltimore & Ohio, has for many years had charge of the designing of the bridges built on the Baltimore & Ohio, with the exception of the Cleveland division, the Pittsburg & Western and part of the Baltimore & Ohio Southwestern. He was born at Wilmington, Del., in 1859, and graduated from Delaware College. He began railroad work in 1885 as draftsman on the Baltimore & Ohio, having had some previous experience in outside companies. In 1889 he was made Assistant Engineer in charge of bridge designing, and in 1891 became Designing Engineer of the Philadelphia Bridge Works. He returned to the Baltimore & Ohio in 1893 as Engineer of Bridges, and in 1899 was appointed Engineer of Bridges and Buildings, which position he has held until his present promotion.

J. E. Greiner.

—Mr. George H. Webb, who has been appointed Chief Engineer of the Michigan Central, is a graduate of the Pennsylvania Military College in the class of 1880. After graduation he went to the Baltimore & Ohio as rodman, and was later levelman and transitman on the Pittsburg Southern and the Pittsburg & Western. In 1883, he became City Engineer of Johnstown, Pa., and was for three years on branch lines of the Chicago, Burlington & Quincy as Assistant Engineer and Locating Engineer. He also located and constructed portions of the Seattle, Lake Shore & Eastern and the Puget Sound, Skagit & Eastern. In 1889 he went to Chile in charge of construction of government railroads. He was appointed, in 1891, Division Engineer and Superintendent of Construction on the Central of Peru, and built the Summit division, which is 15,657 ft. above sea level, and has 57 tunnels in 70 miles, with a 4 per cent. grade and a maximum curvature of 16 degrees. He returned to this country in 1893, and was engaged in private practice for four years. He was then appointed Chief Engineer of the Cincinnati, Georgetown & Portsmouth, and in 1899 became Roadmaster of the Cleveland, Cincinnati, Chicago & St. Louis, later taking the same position on the Chicago & Alton. In 1901 and 1902 he was Engineer in charge of construction of the Baring Cross, Ark., shops of the St. Louis, Iron Mountain & Southern, and in 1903 went to the Michigan Central in charge of location of the Ostimo division. He was appointed Engineer of the Middle division in April, 1903, and Assistant Chief Engineer in November, 1903, which position he held until June 16, of this year, when he was promoted to be Chief Engineer.

George H. Webb.

ELECTIONS AND APPOINTMENTS.

Baltimore & Ohio.—A. P. Prendergast, Master Mechanic of the Philadelphia, Baltimore and Shenandoah divisions, has been appointed Assistant Master Mechanic of the Mt. Clare shops. T. R. Stewart, Master Mechanic at Cumberland, Md., succeeds Mr. Prendergast. J. Kirkpatrick, Master Mechanic at New Castle Junction, Pa., succeeds Mr. Stewart.

Chicago & Alton.—C. B. Stanton, formerly in the engineering department of the Wabash, has been appointed Superintendent of Construction for the new short line between Springfield and Murrayville, Ill., with headquarters at Springfield, Ill.

Chicago City Railway.—Thomas E. Mitten, First Vice-President, has been elected President, and Lawrence A. Young, Second Vice-President, has been elected First Vice-President.

Chicago, Zeigler & Gulf.—James Chamberlain has been elected Auditor.

Durham & Southern.—R. I. Cheatham, formerly Assistant General Freight Agent of the Seaboard Air Line, will take charge of this road, which is in the course of construction.

East Broad Top.—Edgar Shellabarger, General Foreman, has been appointed Master Mechanic.

Erie.—F. J. Moser, Engineer of the Chicago & Erie division at Huntington, Ind., has been appointed Superintendent of that division, succeeding J. M. Barrett. A. Crable succeeds Mr. Moser.

H. B. Hunt, Assistant Mechanical Superintendent at Meadville, Pa., has resigned. A. G. Trumbull, Mechanical Engineer at Meadville, Pa., succeeds Mr. Hunt. G. O. Hammond succeeds Mr. Trumbull.

Fort Worth & Denver City.—Frank T. Dolan, General Superintendent, has resigned. G. F. Cotter, Division Superintendent of the Colorado & Southern, at Trinidad, Col., has been appointed General Superintendent, succeeding Mr. Dolan.

Grand Rapids & Indiana.—W. B. Stimpson, Superintendent of the North division, has been appointed to the new position of Assistant General Manager. J. W. Hunter, Superintendent of the South division, succeeds Mr. Stimpson. B. H. Hudson, Engineer of Maintenance of Way of the North division, succeeds Mr. Hunter.

Great Northern.—G. Willius, Jr., Assistant Mechanical Engineer, has been appointed Mechanical Engineer, succeeding R. D. Hawkins, promoted.

Illinois Central.—E. P. Skene, Land Commissioner, has been appointed Right of Way Agent. The position of Land Commissioner is abolished, the Illinois Central having disposed of all its land grants in Illinois and Mississippi.

Indiana, Illinois & Iowa.—W. R. Sanborn has been appointed Assistant Engineer, with office at Kankakee, Ill.

Indianapolis & Southwestern.—L. B. Pierce, Vice-President of the Commonwealth Trust Co., of St. Louis, has been elected President of this road.

Missouri Pacific.—E. F. Vincent, Chief Draftsman, has been appointed Assistant Engineer at St. Louis, succeeding F. B. Scheetz, promoted.

New York Central & Hudson River.—G. A. Berry, Engineer of Bridges, has been appointed Assistant to the Principal Assistant Engineer of the electric zone, with headquarters at New York. C. P. Marsh has been appointed Bridge Engineer, succeeding Mr. Berry.

New York, New Haven & Hartford.—James N. States, General Ticket Agent, has been retired on a pension after 43 years' service. His duties will be performed by F. C. Coley, Assistant General Passenger Agent.

Northern Pacific.—S. G. Fulton, Assistant General Freight Agent at Portland, Ore., has resigned. F. H. Fogarty, General Agent of the Freight Department at Chicago, succeeds Mr. Fulton.

Henry Blakely, Assistant General Freight Agent at St. Paul, Minn., has been transferred to Tacoma, Wash.

Ohio River & Columbus.—Dennis Sullivan, formerly Superintendent of the Choctaw division of the Missouri, Kansas & Texas, has been appointed Vice-President and General Manager.

Pennsylvania Lines West.—A. C. Watson has been appointed Assistant Chief Engineer of the Indianapolis & Vincennes division.

Pittsburg Terminal Railroad & Coal Company.—The following officers have been elected for this road and for the West Side Belt: B. A. Worthington, Director and Vice-President, succeeding J. W. Patterson, resigned; J. G. Stidger, Assistant Treasurer, and W. M. Bonar, Assistant Secretary and Auditor, both succeeding W. G. Rock, resigned. The following appointments are for the Wabash-Pittsburg Terminal and the Wheeling & Lake Erie, as well as the above roads: D. O. Ives, General Traffic Manager, with headquarters at St. Louis, Mo. H. J. Booth, General Freight Agent, and J. P. Stark, Purchasing Agent.

W. D. Holliday is now Assistant General Freight Agent of the Wabash-Pittsburg Terminal, the Pittsburg Terminal Railroad & Coal Co., and the West Side Belt.

E. B. Coolidge is Assistant General Freight Agent of the Wheeling & Lake Erie.

Seaboard Air Line.—See Durham & Southern.

Southern Pacific.—William H. Averell, Assistant Superintendent of the San Joaquin division, has been appointed Assistant Superintendent at Bakersfield, Cal.

Sumpter Valley.—F. M. Shurtliff, Superintendent, has resigned, and Joseph Barton, General Freight and Passenger Agent, will perform the superintendent's duties.

Tidewater.—H. P. Reigart, formerly Purchasing Agent of the St. Joseph & Grand Island, has been appointed Purchasing Agent of this road, with headquarters at Norfolk, Va.

C. P. Howard, Chief Engineer, has resigned. H. Fernstrom, formerly Chief Engineer of the New York Central & Hudson River, succeeds Mr. Howard.

Wabash-Pittsburg Terminal.—See Pittsburg Terminal.

West Side Belt.—See Pittsburg Terminal.

Wheeling & Lake Erie.—See Pittsburg Terminal.

LOCOMOTIVE BUILDING.

The United Railways of Havana, as reported in our issue of July 14, have ordered eight simple consolidation (2-8-0) locomotives from the Baldwin Locomotive Works for September and October delivery. These locomotives will weigh 125,000 lbs., with 115,000 lbs. on drivers; cylinders, 20 in. x 24 in.; diameter of drivers, 50 in.; Belpaire boiler, with a working steam pressure of 180 lbs.; heating surface, 1,625 sq. ft.; 217 charcoal iron tubes, 2 in. in diameter and 13 ft. long; firebox, 103 in. x 42 in.; grate area, 28.8 sq. ft.; tank capacity, 4,000 gallons, and coal capacity, five tons. The special equipment includes: Westinghouse air-brakes, Washburn couplers, Pyle-National electric headlights, Nathan injector, United States metallic piston and valve rod packings and Nathan sight-feed lubricators.

The Cuba Central, as reported in our issue of July 14, has ordered three simple 10-wheel and three simple consolidation locomotives from the Baldwin Locomotive Works for September delivery. The 10-wheel locomotives will weigh 108,880 lbs., with 79,930 lbs. on drivers; cylinders, 18 in. x 24 in.; diameter of drivers, 56 in.; Belpaire boiler, with a working steam pressure of 180 lbs.; 204 iron tubes, 2 in. in diameter and 12 ft. 9 in. long; steel firebox, $71^{11}/_{16}$ in. x 24 in.; grate area, 16.9 sq. ft.; tank capacity, 3,000 gallons, and coal capacity, five tons. The consolidation locomotives will weigh 108,500 lbs., with 95,000 lbs. on drivers; cylinders, 18 in. x 24 in.; diameter of drivers, 50 in.; extended wagon top boiler, with a working steam pressure of 180 lbs.; 195 iron tubes, 2 in. in diameter and 13 ft. 5 in. long; steel firebox, $78^{11}/_{16}$ in. x 42⅞ in.; tank capacity, 3,500 gallons, and coal capacity, five tons. The special equipment for both types includes: Eames vacuum brakes, Golmar bell ringer, magnesia boiler lagging, Sterlingworth brake-beams, Perfecto brake-shoes, Washburn couplers, Rushmore acetylene headlights, Monitor injectors, Baldwin journal bearings, United States metallic piston and valve rod packings, Crosby safety valves, and Nathan sight-feed lubricators.

CAR BUILDING.

The Chicago & Eastern Illinois has ordered 250 dumping box cars, 750 plain box cars and 1,400 National coal dump cars, all of 80,000 lbs. capacity, from the American Car & Foundry Co., to be delivered in October and November, 1905; and 100 dumping coal cars of 100,000 lbs. capacity from the Pressed Steel Car Co. for January delivery. The dumping box cars will be 36 ft. long, 9 ft. 3½ in. wide and 8 ft. high, inside measurements, and 37 ft. 4 in. long, 10 ft. 5 in. wide and 13 ft. 2 in. high over all, with wooden frames and underframes. The special equipment, aside from that common to all these cars, includes: Vanderbilt brake-beams, National malleable door fastenings, Security doors and Hutchins outside roofs. The plain box cars will be 36 ft. long, 8 ft. 6 in. wide and 8 ft. high, inside measurements, and 38 ft. long, 9 ft. 10 in. wide and 14 ft. high over all, with steel frames and underframes. The special equipment includes: Security and Smith doors and McCord dust guards. The National coal dump cars will be 34 ft. 8 in. long, 9 ft. 9 in. wide and 4 ft. 2 in. high, inside measurements, and 36 ft. 4 in. long, 10 ft. wide and 9 ft. 1 in. high over all, with wooden frames and steel underframes. The special equipment includes Simplex brake-beams. The dumping coal cars will be 40 ft. long, 9 ft. 3 in. wide and 4 ft. 3⅝ in. high, inside measurements, and 41 ft. ½ in. long, 10 ft. 2 in. wide, and 8 ft. 10 in. high over all, with steel frames and underframes. The special equipment includes Pressed Steel bolsters and McCord journal boxes. All these cars will have Hewitt brasses, Chicago couplers and Miner draft rigging.

BRIDGE BUILDING.

Fort Hunter, N. Y.—Plans are being made by the West Shore to build a railroad bridge over the Scoharie at this place, to consist of three spans like the present structure, but much heavier.

Germantown, Md.—The Baltimore & Ohio will build a new stone bridge over Big Seneca creek, east of this place. It will consist of three 65-ft. semi-circular arches.

Intercolonial Railway.—This company will spend $150,000 in strengthening bridges at a number of points on its lines.

LISTOWEL, ONT.—A new steel bridge, to cost $16,000, will be built at Elma street.

MARLIN, TEX.—Two iron bridges will be built over the Brazos river in Falls County.

MEXICO CITY, MEX.—Official announcement has been made that the National of Mexico and the St. Louis, Brownsville & Mexico will jointly build a bridge over the Rio Grande between San Miguel, Mex., and Fordyce, Tex.

MOOREHEAD CITY, N. C.—The Atlantic & North Carolina is reported to be preparing plans for a bridge over Newport river at this place, to cost $200,000.

NORRISTOWN, PA.—Bids are wanted August 19 by the Commissioners of Montgomery County for putting up a single-span steel highway bridge over Zacharias creek, in Worcester township. John H. Dager is engineer in charge.

ORTIZ STATION, MEX.—The Mexican Central, it is said, is planning to build a bridge to consist of seven spans of 250 ft. each over the San Pedro river at this place.

RIPLEY, W. VA.—Bids are wanted by August 9 for a 60-ft. iron bridge over Sand creek, Jackson County, W. Va. G. B. Crow, County Clerk.

SIOUX CITY, IOWA.—The Chicago, St. Paul, Minneapolis & Omaha has given a contract to the Foundation Co., of New York, for putting up a steel viaduct to carry two tracks. Construction work is to be commenced next month.

Permission has been asked of the State Railroad Commissioners by the Sioux City Traction Co. to build a viaduct over the tracks on Wall street, the expense to be jointly borne by the traction company, the various railroads and the city.

TUXPAN, MEX.—On the extension of the Mexican Central from this place to Colima, now under construction, there will be 12 tunnels and several bridges.

Other Structures.

BIRMINGHAM, ALA.—The Birmingham Terminal Co., which was recently organized to build a union passenger station, is preparing plans for a new station and other improvements, which will cost $1,500,000. This station will be used jointly by the Southern, Alabama Great Southern, Central of Georgia, St. Louis & San Francisco and the Seaboard Air Line.

CLARION, IOWA.—Contracts have been let by the Chicago Great Western for a new passenger station at this place. It will cost $15,000, and work will be begun at once.

GUTHRIE, OKLA. T.—The Denver, Enid & Gulf has plans ready for putting up a brick freight house 200 ft. long, to cost $30,000.

INDIANAPOLIS, IND.—The Southern Indiana will build new terminals and shops on the site of the Inter-State stockyards, which it owns.

KANSAS CITY, MO.—The Missouri, Kansas & Texas is buying a large plot of ground to be used as a site for new yards.

The Missouri, Kansas & Texas, to comply with the new 28-hour law governing the shipments of live stock, is building a number of stock yards at various points along its line. They are to be provided with cleaning and disinfecting plants.

KNOXVILLE, TENN.—The Louisville & Nashville will at once rebuild the station recently destroyed by fire.

NEW HAVEN, CONN.—The Consolidated Railway has given a contract for building additions to its shops at Fairhaven; also for putting up a new building three stories high, 32 x 60 ft.

PORT ARTHUR, ONT.—The Canadian Northern has let the contracts for a new passenger station to W. Brown and C. & W. Plaxton, of Winnipeg.

SCRANTON, PA.—Plans have been made by the Delaware & Hudson for putting up a large roundhouse near Parsons, on which work is to be commenced during the present month. It is also proposed to lay out a large coal yard in the neighborhood of Wilkesbarre.

SMITHVILLE, TEX.—The Missouri, Kansas & Texas will enlarge its roundhouse and shops at this place.

SPRINGFIELD, OHIO.—Press reports state that the Pennsylvania Lines West and the Big Four have completed arrangements to build a joint passenger and freight station, which will cost $350,000.

SUSPENSION BRIDGE, N. Y.—The New York Central has commenced work on foundations for a new roundhouse which will have 24 stalls.

SYRACUSE, N. Y.—The Delaware, Lackawanna & Western has bought several acres of ground to be used in enlarging its freight yards.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

BALTIMORE & OHIO.—Contracts have been let to the Chesapeake Construction Co., Baltimore, for double tracking the Metropolitan branch from Gaithersburg to Germantown, Md., 4 miles, and from Barnesville to Dickerson, Md., 2 miles, to F. H. Clement & Co., Philadelphia. The line between these points will be relocated and several heavy grades and curves will be eliminated Work will be begun at once, and it is estimated will cost $600,000.

CANADIAN PACIFIC.—The contract for double-tracking the main line between Winnipeg and Fort William, 427 miles, has been let to Foley Bros., St. Paul, Minn. The work is to be completed in three years, and will be carried on east and west from Rat Portage.

CANADIAN VALLEY & WESTERN.—Dorsett Carter, President of this proposed road from Lehigh to Chokasha, Ind. T., about 125 miles, announces that grading will begin next month at Lehigh. (June 23, p. 206.)

CHICAGO & ALTON.—Work has been commenced on the Iles-Murrayville cut-off in Illinois. It will run under the tracks of the electric interurban road at Iles and above it at Carlinville. The new road will shorten the distance between Chicago and Kansas City about 16 miles.

CHIHUAHUA & PACIFIC.—The Guerrero Valley extension, which is about 53½ miles long, extending from La Junta, on the main line of this road, which runs from Chihuahua to Minaca, down the Guerrero Valley to Temosiachic, passing through a rich agricultural district, was opened for traffic on July 29.

CLEVELAND SHORT LINE.—According to reports from Cleveland, a company under this name has been incorporated in Ohio to build a belt line railroad from Fairport, on the east side of Cleveland, to Lorain, on the west, to cost approximately $10,000,000. It is said that New York and local bankers are back of this project, and that they plan to have work begun soon.

ERIE.—The ordinance providing for the vacation of streets and parts of streets in Jersey City, N. J., in order to enable the Erie to carry out its open cut project, has been settled, and it is said that work will begin at once. President Underwood says that work is to be begun at once on the extensive improvements of the Jersey City and New York Terminals, which were planned many months since.

FULTON COUNTY NARROW GAGE (CHICAGO, BURLINGTON & QUINCY).—This road, which was recently sold to the Chicago, Burlington & Quincy, and which operates about 62 miles of narrow-gage road in Illinois, will be changed to standard gage from Galesburg to Houston, a distance of 50 miles. The remaining 12 miles of the road may be operated as narrow gage, or it may be abandoned.

GILPIN & CLEAR CREEK DISTRICT.—A certificate has been filed by this company in Colorado amending its incorporation papers, changing the capital stock from $50,000 to $1,250,000. The proposed road will be about 17 miles long, to the mines in Gilpin County. It will be a competitor of the Colorado & Southern. John C. McShane is President; Bennett E. Seymour, Secretary, and R. H. Carpenter, Central City, is Chief Engineer.

GLENFIELD & WESTERN.—It is reported that this company is building a five-mile lumber road extension west from Monteala, N. Y.

GREAT NORTHERN.—Work is to be commenced at once by the contractors, Grant, Smith & Co., on double tracking this road from Seattle, Wash., to Everett, about 27 miles. For 22 miles of the distance a retaining wall will have to be built. The cost of the work is approximately $1,250,000.

ILLINOIS CENTRAL.—This company is making surveys for a line to shorten the Memphis and Louisville line. It is to be built from Mayfield northeast to Grand Rivers, Ky., about 30 miles. When completed it will shorten the distance about 25 miles over the present route via Paducah.

INTERSTATE (VIRGINIA).—A contract has been given by this company to J. E. Rodes & Co., of Knoxville, Tenn., for building an extension from Appalachia to Norton, Va., a distance of 10 miles, and from Kelleyview to Roaring Fork, six miles, the work to be finished during the present year. (See Construction Record.)

JALISCO & MICHOACAN.—At a recent meeting of the stockholders the capital stock of this company was increased from $1,500,000 to $10,000,000. Construction work, it is said, will soon be begun in the state of Michoacan. The company is planning to build several hundred miles of road, and has been given a concession by the Mexican Government for this purpose. The company is backed by American capitalists.

LOUISVILLE & NASHVILLE.—This company is reported to have completed a survey for a cut-off for a distance of about 30 miles from La Folette, Tenn., northeast up the Powell valley to its Corbin-

Norton branch at Cumberland Gap. The projected line would be about 80 or 90 miles shorter than the present route.

Mexican Roads.—A company of Mexican capitalists of Tlachichilco, state of Vera Cruz, is planning to build a railroad from that place southeast through La Perla, Aztecan and Coscomatepec, in the state of Vera Cruz, a distance of about 75 miles.

Michigan Central.—The new double-track line of this company has been completed between Kalamazoo and Mattawan, 12 miles, and train service begun over it. The old line has been abandoned.

New York Central.—This company has bought the Grand Central Palace block for extending its new terminal improvements in New York City. The price paid for the property was $355,000.

North Carolina & Ohio.—A charter has been granted this company in North Carolina to build a railroad from Raleigh, N. C., east through Wilson and Greenville to Washington, approximately 90 miles. The directors include: C. O. Haines and Adam Tredwell, of Virginia; John S. Cunningham, Steven C. Bragaw, L. J. Moore, C. M. Brown, W. Bragaw and others, of North Carolina.

Norway & Western.—This company, which was recently incorporated in Maine, has been granted permission by the town of Norway to locate its line at that place, and it is said that the road is to be completed during the present year. (June 23, p. 207.)

Omaha, Lincoln & Beatrice (Electric).—A contract has been given by this company to J. H. Piper, of Ashland, for grading its proposed road from Ashland, Neb., to the Platte river, and the work is now under way. (March 31, p. 102.)

Oregon Railroad & Navigation.—A contract has been given by this company to Erickson & Peterson, contractors, of San Francisco, for building the proposed extension of this road from Raparia, Wash., east along the north bank of the Snake river to Lewiston, Idaho, a distance of about 78 miles. The work includes the removal of a great amount of rock. The cost of the work will be between $1,700,000 and $2,000,000. (June 16, p. 199.)

Overton County R. R.—The contract for building 19 miles of this road from Algood, Tenn., north to Livingston has been let to the Cumberland Construction Co., of Livingston, Tenn. (See Construction Record.)

Southern.—Bids will soon be asked by this company for grading its proposed new line from Chattanooga, Tenn., to Stevenson, Ala., a distance of 42 miles. (April 28, p. 144.)

Texas Roads.—A syndicate of capitalists of Cincinnati, Ohio, in connection with Mayor T. W. Perkins, of McKinney, Tex., is planning to build a railroad from McKinney to Decatur.

Toledo, Defiance & Southern.—This company has been incorporated in Ohio with a capital of $10,000,000, to build an electric road from Toledo to Cincinnati.

Wallowa Valley.—Incorporation has been granted this company in Oregon, with a capital of $500,000, to build a railroad from Elgin, Ore., down the Grand Ronde to the mouth of the Wallowa and up that river to the valley of the same name in eastern Oregon. It is proposed to extend the road eventually to Joseph, a total distance of 35 miles. Surveys are now being made, and it is said that the rights of way have been secured as far as the Wallowa river. The incorporators include T. S. Potter, George F. Heusner and Robert Bell.

Western Maryland.—Surveys, it is said, will shortly be made by this company to locate a low-grade line from some point on the main line above Westminser, Md., to Williamsport. Two routes are under consideration. One, starting at Westminster, runs direct to Frederick, thence west to Catoctin and South Mountains, where it is proposed to pierce a tunnel about two miles long. The other route begins on the main line near Monocacy and traverses a level section, striking the South Mountain at about the same point as the other route.

RAILROAD CORPORATION NEWS.

Baltimore & Ohio.—The passenger trains of the Ohio River division of this road, running through to and from Pittsburg, which, under an arrangement made long before the B. & O. acquired the division, have hitherto been run over the Pittsburg, Cincinnati, Chicago & St. Louis, are now run over the Pittsburg-Wheeling line of the Baltimore & Ohio.

Beaver Valley Traction (Electric).—The control of this company has passed into the hands of the Pittsburg Railways Company, which in turn is controlled by the Philadelphia Company, of Pittsburg, Pa., these interests having bought the bulk of the $1,075,000 stock. J. D. Callery has been elected President.

Chicago & Western Indiana.—Harvey Fisk & Sons, of New York, are offering at 100 and interest $500,000 consolidated mortgage 4 per cent. gold bonds of 1952. These bonds are a part of an authorized issue of $50,000,000.

Cincinnati, Flemingsburg & Southeastern.—This Kentucky company, successor to the Covington, Flemingsburg & Ashland, has executed a mortgage for $30,000 to secure that amount of 5 per cent. 20-year gold bonds, dated June 1. Provision is made for a sinking fund into which $1,500 is to be paid yearly. The President of the company is Attilla Cox, Louisville; Vice-President, C. D. Lanier, New York. (June 19, p. 192.)

Erie.—A dividend of 4 per cent. has been declared upon the $16,000,000 of second preferred stock, 2 per cent. payable in October, 1905, and 2 per cent. in April, 1906. This is the first dividend ever declared on the second preferred stock. The usual semi-annual dividend of 2 per cent. on the first preferred stock was also declared.

La Fayette.—This railroad, 22 miles long, extending from La Fayette, Ala., to Opelika, is being torn up. According to a press despatch from Opelika the road has been idle for several months, pending litigation as to what should be done with it, and the officers of the road finally began tearing up the track, though against the protest of citizens along the route. An injunction was secured restraining the officers, but it appears that the persons who secured the injunction have been satisfied in some way, and the work of destruction is going on. The road was built ten years ago, largely by subscriptions of citizens, for the purpose of securing a competing line to relieve the people from alleged extortionate freight rates. The President of the road is G. E. McGehee.

Lehigh Valley Transit (Electric).—This is the name which is to be given to the new company to be organized to take over and operate the lines of the Lehigh Valley Traction Co. and the Philadelphia & Lehigh Valley Traction Co., recently sold at foreclosure sale, as outlined in the *Railroad Gazette* of May 19, page 168. The President of the new company will be H. C. Trexler, of Allentown, Pa., who is President of the three companies now in possession of the properties as a result of the purchases in the foreclosure proceedings. It is said that the new company will have $3,000,000 of common stock and $5,000,000 preferred stock, and will issue $7,500,000 of 4 per cent. bonds.

Missouri, Kansas & Texas.—This road has withdrawn the suit which was filed to secure possession of land in the Indian Territory valued at $40,000,000, which the road claimed under a grant made by the government about 30 years ago.

Morris County Traction (Electric).—This New Jersey Company has executed a mortgage to the Trust Company of America (New York) to secure an issue of $3,000,000 5 per cent. thirty-year bonds, redeemable at 110. The company has $3,000,000 capital stock, of which $400,000 is outstanding. It has in operation seven and a half miles of road, extending from Wharton, N. J., via Dover to Rockaway, and expects to build 60 miles of new line.

New York, New Haven & Hartford.—This company has acquired a controlling interest in the stocks and bonds of the Newburgh, Dutchess & Connecticut, which runs from Dutchess Junction, N. Y., northeastward to Millerton, 57 miles. The majority in interest of the $500,000 common stock and the $600,000 preferred stock was bought for $6 a share, and of the $1,164,500 6 per cent. income bonds of 1977 and the $226,000 collateral trust 5 per cent. bonds of 1921, at 50.

Pittsburg, Shawmut & Northern.—The Central Trust Co., Trustee under the first mortgage, has applied for the appointment of a receiver for this road, and under orders of the United States District Court in Pennsylvania and the Supreme Court of the State of New York, Frank Sullivan Smith has been appointed receiver. His office is in New York, and he took charge of the road's affairs on August 1. The length of the road owned by this company is 122 miles, and it leases the Clarion River and the Rochester, Hornellsville & Lackawanna, making a total (including 11 miles of trackage rights) of 168 miles. The capital stock outstanding June 30, 1903, was $11,700,000; funded debt, $6,583,600; car trust notes and other liabilities, $723,730.

Western Maryland.—It is announced in Baltimore that this company is to amalgamate with itself all of the eastern roads controlled by the Wabash, which form a part of the Tidewater line. The roads concerned are the Western Maryland, the Potomac Valley of Maryland and the Potomac Valley of West Virginia; the Western Maryland Tidewater, the Piedmont & Cumberland of Maryland and the Piedmont & Cumberland of West Virginia; the West Virginia Central of Maryland and the West Virginia Central of West Virginia, and the Coal & Iron. The lines in Pennsylvania controlled by the Western Maryland will not be affected by the merger, and it is only proposed at this time to unite those which will be directly concerned in forming the East and West Wabash trunk line to Baltimore.